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EPA Superfund
Record of Decision:

APACHE POWDER CO.
EPA ID: AZD008399263
OU 01
SAINT DAVID, AZ
09/30/1994

Apache Powder Superfund Site

Record of Decision

Apache Powder Superfund Site

St. David, Arizona

United States Environmental Protection Agency
Region 9 - San Francisco, California

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PART I: DECLARATION FOR THE RECORD OF DECISION

1.0 Site Name and Location

Apache Powder Superfund Site (CERCLIS ID #AZD008399263)
(7 miles south of Benson, Arizona)

2.0 Statement of Basis and Purpose

This decision document presents the remedial action selected by the U.S. Environmental Protection Agency (EPA) for the Apache Powder Superfund site in St. David, Arizona, which was chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan and the Clean Water Act. This decision is based on the Administrative Record for this site.

The State of Arizona concurs with the selected remedy.

3.0 Assessment of the Site

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response actions selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

4.0 Description of the Remedy

This remedial action includes measures to clean up nitrate-contaminated groundwater and contaminated soils at the site. This action addresses the principle threats at the site: exposure to contaminated water (through pumping and treating nitrate-contaminated perched and shallow aquifer groundwater and through shallow aquifer domestic water well replacement) and exposure to contaminated soils (through on-site containment, off-site treatment and disposal, and institutional controls).

The major components of the selected remedy include:

- Completing additional groundwater investigations to determine the extent of nitrate contamination and to determine the appropriate rates and locations for groundwater withdrawal and recharge;

- Extracting and treating the perched groundwater by forced evaporation (brine concentrator), in conjunction with treatment of the company's process wastewaters, to meet the federal and state drinking water standard of 10 parts per million (ppm) for nitrate;

- Extracting and treating the shallow aquifer by use of constructed wetlands to meet the federal and state drinking water standard of 10 parts per million (ppm) for nitrate, and recharging the treated water through wetlands, agricultural irrigation, discharge or some combination of these methods as determined during Remedial Design;

- Replacement of contaminated shallow aquifer domestic wells with deep aquifer wells;

- Implementing institutional controls so that future use of the site is compatible with the remedial goals and maintaining the protection provided by the clay caps;

- Groundwater monitoring;

- Clay capping of 10 Inactive Ponds with no disturbance to contaminated soils;

- Excavating and removing nitrate-contaminated soils and drums of vanadium pentoxide from the White Waste Material and Drum Storage Area to an off-site facility for treatment and disposal; and

- Excavating and removing dinitrotoluene-contaminated soils, and any lead-contaminated soils which may be discovered, from the Wash 3 Area (excluding the Ash and Burn Area) to an off-site facility for treatment and disposal.

5.0 Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy uses permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable for this site. This remedy satisfies the statutory preference for treatment as a principal element. Because this remedy will result in hazardous substances remaining in some soils on-site above background or soil action levels, in addition to monitoring required as part of ongoing operation and maintenance, a review will be conducted within five years after commencement of the remedial action, in addition to annual monitoring, to ensure that the remedy continues to provide adequate protection of human health and the environment.

______________________________	______________________________
Felicia Marcus Regional Administrator Unites States Environmental Protection Agency Region IX	Date

PART II: DECISION SUMMARY

1.0 Site Name, Location, and Description

The Apache Powder Superfund site is located in Cochise County in southeastern Arizona, about seven miles southeast of the incorporated town of Benson and approximately 50 miles southeast of Tucson. The site study area includes approximately 1,000 acres of land owned by Apache Nitrogen Products, Inc. (ANP), formerly known as the Apache Powder Company. The site study area also includes areas of nitrate-contaminated groundwater and surface water located outside ANP's property boundary. The site is bordered on the east by the San Pedro River (Figure 1).

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2.0 Site History

ANP began operations in 1922 as a manufacturer of industrial chemicals and explosives. Currently, ANP manufactures nitric acid, solid and liquid ammonium nitrate, blasting agents, and nitrogenous fertilizer solutions. ANP also distributes explosives materials to mining companies.

Prior to 1971, facility wastewater composed of wash-down and blow-down waters from its power house cooling tower, nitric acid plant, and from the loading, unloading, and storage of raw materials and products was discharged on site into dry washes which flow to the San Pedro River. Since 1971, wastewater has been discharged into unlined evaporation ponds on site causing contamination of a perched water zone, the shallow aquifer, and the surface water to the San Pedro River (Figure 2). The site was first identified as an environmental problem in the early 1980s, proposed by EPA for listing on the National Priorities List in 1986, and placed on the list in 1990.

3.0 Enforcement Activities

EPA

In April 1988, EPA issued a Special Notice Letter to ANP notifying ANP of its liability and offering the opportunity to conduct and finance a Remedial Investigation/Feasibility Study (Rl/FS). In October 1989, EPA issued ANP a Unilateral Administrative Order (UAO) under Section 106 of CERCLA for completion of the Rl/FS. However, in a June 1993 meeting EPA verbally informed ANP that revisions to the Rl/FS reports would be necessary. By letter of October 29, 1993, ANP was informed that EPA would revise both reports. EPA completed the revised Rl and FS reports in June 1994.

EPA conducted a search for other potentially responsible parties, which included the issuance of numerous CERCLA 104(e) letters. In May 1994, EPA sent a general notice letter to Phelps Dodge Corporation notifying the company of potential liability.

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STATE

ANP has interim status under the Resource Conservation and Recovery Act (RCRA) for treatment of explosive wastes in its Ash and Burn Area. The Ash and Burn Area, also known as the Open Burn/Open Detonation (OB/OD) Area, is currently undergoing closure review by the Arizona Department of Environmental Quality (ADEQ) under its RCRA program authority. In June 1994, ANP and ADEQ signed a State Consent Decree (CD) containing a schedule for bringing ANP into compliance with State hazardous waste and aquifer protection regulations and permitting requirements. As a component of the CD, ANP currently is constructing a brine concentrator to treat the industrial process wastewater that historically has been the primary source of groundwater contamination at the site.

4.0 Summary of Site Characteristics

The site characteristics of the Apache Powder site are based on numerous investigations conducted by both ANP and by EPA. A Preliminary Investigation (PI) was completed in 1988 by EPA.

ANP completed several studies (Soils Investigation, Source Control Plan, Study Area Survey, Hydrogeological Analysis, and San Pedro River Supplemental Sampling) in 1990 and 1991. These studies were summarized in ANP's 1992 Remedial Investigation (RI) Report. In 1993, ANP completed an additional report on the Wash 3 and Drum Disposal Area Investigation. A summary of these investigations is included in Appendix C of the FS report. The media-specific reports (available in the Administrative Record) provide a detailed description and analysis of contaminants found at the site.

The contamination present on-site at the Apache Powder site exists in the soil and groundwater. The following Chemicals of Concern (COC) and other waste materials have been identified in the five media areas addressed by this selected remedy (Figure 3).

- Perched Groundwater - Arsenic, Fluoride, and Nitrate
- Shallow Aquifer - Nitrate
- Inactive Pond Soils and Sediments - Antimony, Arsenic, Barium, Beryllium, Chromium, Lead, Manganese, and Nitrate
- White Waste Materials and Drum Storage Area - Nitrate, Vanadium Pentoxide *
- Wash 3 Area (Excluding the Ash and Burn Area or OB/OD Area) - 2,4-Dinitrotoluene (DNT), 2,6-DNT, Lead, and Paraffins *

* Waste Materials

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5.0 Summary of Site Risks

The information on site risks is taken from the Baseline Public Health Evaluation and Ecological Assessment completed by EPA (ICF, Inc.) in September 1992, with additional information being provided in the revised EPA FS report of June, 1994.

The health evaluation process included: (a) identifying contaminants from historical operations that are currently present in the groundwater, surface water, soils and sediments; (b) characterizing the population potentially exposed to these contaminants; and (c) evaluating the potential health effects from exposure to contaminated groundwater, surface water, soil and sediments. EPA evaluated how individuals might be exposed to these contaminants under both current and future conditions. Potential risks to natural resources also were evaluated.

5.1 On-Site and Off-Site Exposure Pathways

The site is currently zoned for industrial use. There is a possibility that the site may be rezoned and redeveloped for residential use. Hence, exposure conditions associated with industrial and residential use of the site were used in the estimation of risk. In addition, risk to on-site trespassers was estimated. Because there are occupied houses within one-half mile of the site, the potential risk to occupants of the closest homes was also estimated. Those are homes located north, northwest (NNW) and east, northeast (ENE) of the site.

Exposure of on-site workers (adults), residents (children and adults), and trespassers (children and adults) was assumed to occur through ingestion of soil and inhalation of airborne soil (dust) generated by wind. Exposure of on-site workers to contaminated groundwater was considered unlikely because the water supply for current on-site workers is the uncontaminated deep aquifer. Trespassers would use the same water supply. The perched and shallow aquifer groundwater are recharged by wastewater evaporation ponds on the site. Redevelopment of the site for residential use would remove the evaporation ponds and therefore the source of the contaminated wastewater, impacting both the perched and shallow aquifer groundwater. Consequent disappearance (e.g., dewatering) of the perched groundwater would remove the source of contamination and, over the long-term, reduce the potential for exposure of future on-site residents to contamination in the shallow aquifer groundwater.

To ensure a conservative, protective approach, off-site residents were assumed to be exposed to windblown soil both by inhalation of airborne particles and ingestion of deposited particles and assumed to be exposed to contaminated groundwater by ingestion of water from private wells.

5.2 Average and Reasonable Maximum Cancer Risks

Total risk estimates are the sum of the risks presented by all chemicals by inhalation and ingestion. Each cancer risk estimate is an estimate of the probability that a person will develop cancer during a lifetime if exposed to the evaluated carcinogens under the conditions assumed in the risk assessment. For risk assessment purposes, a cancer risk less than 1.0 x 10-6 was considered insignificant.

For all the receptors except the on-site worker and future on-site resident, the total average and total reasonable maximum cancer risks associated with exposure to soil are less than one-in-one million (1.0 x 10-6). Cancer risk is highest with the future resident, for which the average risk ranged from 6.1 x 10-6 to 2.3 x 10-5 and reasonable maximum risk ranged from 1.1 x 10-5 to 8.9 x 10-5. The chemicals that contributed most to the total cancer risk to the future on-site resident and the current on-site worker are hexavalent chromium and arsenic in soil.

For the off-site resident (NNW and ENE), cancer risk associated with exposure to soil by inhalation and ingestion is low (on the order of 1.0 x 10-8 to 1.0 x 10-9). For the resident living ENE of the site, consumption of groundwater presents a risk of 1.4 x 10-5 to 8.8 x 10-5 due to the presence of arsenic above background levels in the water. Groundwater from monitoring wells NNW of the site did not contain arsenic, which was the only carcinogen among the chemicals evaluated. Therefore, consumption of the groundwater does not present a cancer risk to NNW residents.

5.3 Noncancer Risk

Each noncarcinogenic risk estimate is the ratio of the calculated risk to the nontoxic dose. For individual chemicals, the ratio is called a hazard quotient. A hazard index is the sum of the hazard quotients. When a hazard quotient or a hazard index exceeds 1.0 (1.0E+00) toxic effects could occur. When these measures of noncancer risk are less than 1.0, the occurrence of toxic effects is unlikely.

GROUNDWATER

Noncancer risk associated with exposure to shallow aquifer groundwater is significant for off-site residents, with a hazard index ranging from 1.7 to 39.

A primary human health risk posed by the site is the potential direct ingestion of nitrate-contaminated shallow aquifer groundwater. Nitrate is the primary contaminant of concern due to the potential ingestion risk to infants that could result in methemoglobinemia ("cyanosis"). This condition, commonly referred to as "blue baby syndrome", occurs when nitrate, having been converted to nitrite, is absorbed into the bloodstream and produces methemoglobin. Methemoglobin is not capable of carrying oxygen through the bloodstream to the same extent as hemoglobin. The skin takes on a blue pallor due to the lack of oxygen. Infants less than four months of age are more susceptible to this condition because of higher levels of bacteria in their stomachs and intestines. Most cases of infant methemoglobinemia are associated with exposure to nitrate in drinking water used to prepare infants' formula at concentrations greater than 20 parts per million (ppm).

SOILS

Noncancer risk associated with average inhalation exposure to soil is significant for the future on-site resident. For the infant, child, and adult, the hazard indices range from 1.1 to 2.5. Under reasonable maximum exposure conditions, the inhalation hazard indices exceed 1.0 for the on-site worker and the future on-site resident. Noncancer risk associated with ingestion of soil is not significant. Where noncancer risk is significant, the risk is due almost entirely to hexavalent chromium.

5.4 Potential Ecological Impacts

EPA has coordinated, and will continue to coordinate, extensively with the U.S. Fish & Wildlife Service (USFWS), the Bureau of Land Management (BLM), and the Arizona Game and Fish Department, regarding any potential ecological risks associated with site activities.

6.0 Interim Cleanup Actions Conducted to Date

6.1 Alternative Water Supply

While investigations proceeded and alternatives were reviewed for cleanup of the site, interim actions were taken to address potential threats to public health. In 1989, ANP began supplying bottled water to nearby residents with nitrate-contaminated drinking water wells (wells exceeding the federal drinking water standard for nitrate). In November 1993, EPA requested that ANP submit a revised plan to install permanent replacement drinking water wells for those households with nitrate contamination exceeding the maximum contaminant level (MCL) of 10 ppm. In February 1994, the contaminated shallow aquifer wells were resampled by ANP to establish current water quality data. As of September 1994, ANP has installed four deep aquifer replacement wells. Four more wells are scheduled for replacement in the fall of 1994. This selected remedy includes modification and continued implementation of this well replacement project. (See page 2-29.)

6.2 Wash 3 Soils Cleanup

An investigation of the Wash 3 Area began in 1989. The Wash 3 Area includes the Wash 3 channel leading to the San Pedro River, a drum disposal area, and an area informally called the Main Accumulation Area. (The Ash and Burn or Open Burn/Open Detonation Area is also located within the Wash 3 watershed, and cleanup of the area will be overseen by the Arizona Department of Environmental Quality.) The investigation included an inventory of the drums and stained soils and a geophysical survey. A total of 127 drums were observed and inventoried, and seven stained soil areas were identified. Excavation and removal of deteriorated 110-gallon steel drums, estimated to be 30-40 years old, began in January 1991. Approximately 230 cubic feet of oily soil were excavated and removed from the Wash 3 area to a fenced on-site storage area.

Additional activities were conducted in May 1993, including further inventorying of drums, sampling of stained soil areas, and excavation of 45 cubic yards of dinitrotoluene (DNT)-contaminated soil. The final phase of the Wash 3 cleanup (included in this selected remedy) will be to consolidate and transport the drums, excavated soils (currently secured in the temporary on-site storage area) and additional soils requiring excavation for off-site treatment and disposal (Figure 3).

7.0 Highlights of Community Participation

EPA has consistently kept the community surrounding ANP apprized of developments and has solicited the community's input on site activities. Beginning in 1990, EPA's outreach has included fact sheets, public meetings and informal communications with community members.

On September 13, 1990, a community meeting was held in St. David, Arizona to discuss upcoming activities related to site cleanup. This meeting was followed by an Open House on May 30, 1991 to give community members an opportunity to speak with EPA and state staff on the progress at the site.

In February 1994, while EPA was reviewing ANP's revised Alternative Drinking Water Supply Plan, EPA staff met informally with several well owners to discuss the deep well replacement plan. On March 22, 1994, a presentation was given by ANP with EPA and state involvement on the hydrogeological features of the San Pedro Basin, the nitrate-contamination in the shallow aquifer, and the details of the proposed new wells.

EPA held two meetings in Arizona regarding the potential use of constructed wetlands as one component of EPA's preferred remedy. On April 25, 1994, a meeting was held in Phoenix with representatives from state and federal agencies. A technical meeting also was conducted on June 2, 1994 with representatives from public interest groups, university research staff, and state and federal agencies to further discuss the constructed wetlands concept and to gather information that EPA should consider prior to issuing the Proposed Plan.

In June 1994, EPA released the Proposed Plan for five areas with groundwater or soils contamination due to historical practices at the facility. At the same time, EPA gave notice that a public meeting would be held on July 6, 1994 in St. David, Arizona, and that a public comment period would be open from June 23, 1994 through July 25, 1994. EPA also made the Administrative Record available in the information repository maintained at the Benson Library. In addition, the Proposed Plan was mailed to interested individuals on the mailing list. The notice of availability of the Rl reports, FS, Proposed Plan, and the rest of the administrative record, the start of the comment period and the scheduled Public Meeting was published in the San Pedro Valley News on June 22, 1994. On the same date, EPA also issued a press release on the proposed cleanup plan.

At the July 6, 1994 public meeting, representatives from EPA presented the Proposed Plan. Questions regarding the Proposed Plan and other site cleanup activities were answered by representatives from EPA, the State, and other technical experts. EPA also accepted written and verbal comments from the public.

In light of the level of interest expressed during the public comment period, EPA will provide additional opportunities for community input during the remedial design (RD) process. The transcript of the July 6, 1994 meeting and the Responsiveness Summary, Part III of this ROD, contain information on community concerns and EPA's responses to these concerns.

8.0 Scope and Role of Selected Remedy

EPA's selected remedy addresses cleanup of historical contamination affecting groundwater and soils. Concurrently, ADEQ is addressing the company's on-going manufacturing processes to reduce or eliminate the threat of future contamination. The EPA and the State of Arizona are coordinating their respective activities to ensure that the cleanup activities performed by ANP are comprehensive and do not duplicate company or agency effort. EPA's selected remedy addresses the following five media areas (Figure 3):

- Perched Groundwater
- Shallow Aquifer
- Inactive Pond Soils and Sediments
- White Waste Materials and Drum Storage Area
- Wash 3 Area (Excluding the Ash and Burn Area)

9.0 Summary of Remedial Action Alternatives - Groundwater Cleanup

The alternatives summarized here were presented in the Proposed Plan. A detailed evaluation of all the alternatives is presented in the EPA FS report, dated June 1994. Several alternatives were screened out prior to the nine-criteria analysis used to evaluate the alternatives presented in the Proposed Plan, including agricultural irrigation. However, due to comments received during the public comment period which proposed the use of adjacent private properties for irrigation, EPA will reconsider agricultural irrigation as a secondary treatment/recharge option for the shallow aquifer groundwater during the first phase of the RD.

9.1 No Action

The No Action alternative, required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.430(e)(6)), provides, among other things, an analysis of the risk posed by the facility if no remedial action is conducted. Therefore, it is used as a baseline alternative against which other alternatives are measured. With this alternative, there would be no reduction of toxicity, volume or mobility of the nitrate contamination in the perched and shallow aquifer. The contamination would be allowed to remain in the groundwater with the potential for movement to additional private wells northwest of the site. The only actions that would take place would be periodic groundwater monitoring to track the fate of the nitrate plume, and five year reviews to evaluate the overall site conditions over time. The cost of this alternative would be approximately $65,000 per year for additional monitoring. The No Action approach is unacceptable to EPA because threats to human health and the environment from groundwater contamination would continue to exist.

9.2 Pumping or Well Drilling Restrictions

Pumping or well drilling restrictions are institutional controls placed on a property to restrict types of use. In general, institutional controls are either (1) government controls imposed by state or local governments; or (2) proprietary controls, such as deed restrictions, whereby a party holding an interest in property restricts the use of that property. The purpose of institutional controls is to prevent use of the site that could facilitate contact with contaminants. The restriction on use of the property depends on the level of contamination that exists on the parcel and the risks posed by that contamination.

9.3 Alternative Water Supply

Implementation of an alternative drinking water supply is another response action that was considered. Bottled water is currently being supplied to a number of households located north of the ANP property, until a permanent deep aquifer replacement well system can be installed. In addition to replacement wells, other alternatives include installation of wellhead treatment systems or construction of a pipeline to hook up new and existing residences impacted by the nitrate contamination to the St. David public water supply. Wellhead treatment systems are complex and generally unreliable for the contaminants of concern unless they are professionally maintained. Therefore, wellhead treatment is infeasible at the site. Construction of a pipeline to provide potable water for new residents to the affected area could be a viable alternative to deep wells.

9.4 Pumping and Treating Groundwater

Contaminated groundwater can be treated either in the ground (in situ) or pumped out of the aquifer and treated at the surface. The treated groundwater can then be returned to the aquifer (by injection or infiltration), reused at the surface, evaporated, or discharged to surface water. The following biological, physical, and chemical treatment technologies were initially considered for treating extracted groundwater at The Apache Powder site.

Biological Treatment	Physical Treatment	Chemical Treatment
High Rate Denitrification - Reactors/Tanks	Forced Evaporation (Brine Concentrator)	Ion Exchange
Low Rate Denitrification - In Situ	Reverse Osmosis (RO)	Chemical Precipitation
Low Rate Denitrification - Constructed Wetlands	Electrodialysis Reversal (EDR)	Electrochemical Precipitation
	Solar Evaporation	
Low Rate Denitrification - Land Application	Distillation	

These technologies were screened in the FS report. Five technologies were retained for further evaluation for the perched groundwater and four were retained for the shallow aquifer. The FS report and the glossary in the Proposed Plan contain a brief description of these technologies. Detailed analyses of the technologies retained for the two groundwater media areas are summarized in Table 1 for the Perched Groundwater and in Table 2 for the Shallow Aquifer.

Table 1:

Perched Groundwater
(Nitrate, Flouride, and Arsenic Contamination)

EPA's Preferred Alternative

Alternative	Alternative Description	Effectiveness	Implementability	Costs (million $)
P-1A: No Action (Continued Monitoring	Status quo	Not effective	Implementable	$0.09
P-2: Anaerobic Denltrification (Biological Treatment)	Extraction from 7 wells; biological treatment in a closed reactor vessel; evaporation and disposal of waste sludge; reinjection or recharge to shallow aquifer, or discharge to the San Pedro River	Potentially capable of 97% efficiency for nitrate removal; does not remove fluoride and arsenic without additional treatment	Implementable; requires pilot treatability studies	$2.96
P-3: Solar Evaporation	Extraction from 7 wells; evaporation form lined ponds	Totally eliminates extracted groundwater; leaves solid waste matter requiring disposal	Implementable	$3.32
P-4: Forced Evaporation (Brine Concentrator)	Extraction form 7 wells; evaporation with a brine concentrator and condensation of distilled water; reuse of the treated water in the ANP plant	Highly efficient for removal of and total dissolved solids (TDS), including nitrate, fluoride, and arsenic	Implementable; could be implemented as part of ANP's installation of a brine concentrator for process wastewaters	$2.35
P-5A: Reverse Osmosis (RO) (Physical Treatment)	Extraction from 4 wells; physical treatment with a semi-permeable membrane; reuse of the treated water in the ANP plant, reinjection or recharge to the shallow aquifer, or discharge to the river	Highly efficient for removal of all TDS including nitrate, fluoride, and arsenic	Implementable	$3.49
P-5B Electrodialysis Reversal (EDR) (Physical treatment	Extraction from 4 wells; physical treatment with permeable membranes; reuse of the treated water in the ANP plant reinjection or recharge to the shallow aquifer, or discharge to the river	Highly efficient for removal of all TDS including nitrate, fluoride, and arsenic	Implementable	$3.72

Table 2: **Shallow Aquifer Groundwater (Nitrate Contamination)** **EPA's Preferred Alternative**

Alternative	Alternative Description	Effectiveness	Implementability	Cost (million $)
GS-1A: No Action (Continued Monitoring)	Status quo	Not Effective	Implementable	$0.39
GS-2A: Anaerobic Denitrification (Biological Treatment)	Extraction from 4 wells; biological treatment in a closed vessel; recharge or reinjection to the shallow aquifer, or discharge to the San Pedro River	Potentially capable of 97% efficiency for nitrate removal with 2-stage design	Implementable requires pilot treatability studies	$17.60
GS-2B: Constructed Wetlands (Biological Treatment)	Extraction from 4 wells; biological treatment in shallow basins with aquatic plants; recharge or reinjection to the shallow aquifer, or discharge to the San Pedro River	Potentially capable of 97% efficiency for nitrate removal; TDS incorporated into system	Implementable; requires longer terms start-up period	$16.19
GS-3A: Reverse Osmosis (RO) (Physical Treatment)	Extraction from 4 wells; physical treatment with a semi-permeable membrane; recharge or reinjection to the shallow aquifer or discharge to the San Pedro River	Highly efficient for removal of nitrate and all TDS	Implementable	$22.65
GS-3B: Electrodialysis reversal (EDR) (Physical Treatment)	Extraction form 4 wells; physical treatment with permeable membranes; recharge or reinjection to the shallow aquifer, or discharge to the San Pedro River	Highly efficient for removal of nitrate and all TDS	Implementable	$23.02

10.0 Summary of Remedial Action Alternatives - Soil Cleanup

EPA considered a number of soil alternatives to reduce the risks from potential exposure to the contaminants and to prevent migration of contaminants to groundwater or surface water at concentrations that would pose a threat to human health. The Proposed Plan summarized these alternatives. The alternatives summarized here also were evaluated in detail in EPA's FS report.

10.1 No Action

Under this alternative, contaminated soils would be left in place on-site, without removal or treatment to diminish potential threats to human health and the environment. With this alternative, there would be no reduction of toxicity, volume or mobility of the contaminants. The only actions that could be conducted under this alternative would be re-seeding of any areas where vegetation was disturbed by on-site activities during the investigation, periodic monitoring required by CERCLA (because wastes will be left on-site), and five year reviews to evaluate site conditions over time.

10.2 Deed Restrictions and Fencing

Site access would be restricted under this alternative to prevent exposure to contaminated soils. Measures would include placing a notice on the deed, restricting development on parcels within the site boundary that could cause exposure to contamination, and/or fencing selected areas of the site. While the property owners would have the ability to propose future uses to EPA for review and approval, the institutional controls will ensure that any future use is protective of human health.

Because contamination would remain on-site, annual monitoring along with a series of five-year reviews to evaluate changes in site conditions would be required for this alternative. Annual monitoring would include soil and the underlying groundwater.

10.3 Capping

Capping consists of placing compacted fill over the contaminated areas and covering this fill soil with a low permeability clay. Placing a second layer of asphalt concrete, Portland cement concrete, or a synthetic geomembrane over the clay cap could be used to further reduce the permeability of the cap. The goal of this alternative is to prevent exposure to contamination, so land use decisions would take exposure scenarios into consideration.

Land use restrictions would be implemented to prevent activities that might breach or damage the cap and to restrict use of properties with residual contamination so that potential contact with contamination beneath the properties is prevented. Because the contamination would remain on-site for all areas under this alternative, 5-year reviews would be required. The annual monitoring strategy for all the areas covered by this alternative would include cap stability evaluations, monitoring groundwater over time, and other methods determined to be necessary during the RD.

Vegetation planted on the soil and clay cap must be low-maintenance and be drought tolerant. Also, the root systems of the selected plants will be fairly shallow, so that the roots do not penetrate the clay layer. The plants will also be chosen to maximize erosion protection along the slopes. At a minimum, the vegetation should be sustainable for the climate of the Benson/St. David area without irrigation (after initial planting).

10.4 Surface Controls

Surface control alternatives would include grading the areas surrounding the contaminated areas to prevent surface water from flowing onto pond areas, stabilizing the pond sediments by constructing erosion prevention structures, and diverting and collecting water in lined ditches and canals to prevent surface runoff from flowing into the pond areas. Because of the heavy summer rains, surface controls will be needed.

10.5 Soil Treatment

This alternative involves treating the contaminated soils in place (in situ) or removing and treating them physically or biologically to remove the contaminants of concern. Physical treatment methods include physically removing (leaching) the contaminants from the soil, or melting soil particles and contaminants into a solid mass (vitrification). Biological degradation consists of enhancing the breakdown of contaminants by naturally occurring aerobic or anaerobic microorganisms in the soil. Chemical treatment alternatives include the use of chemicals that bond the contaminants contained within the soil mass, thereby reducing their mobility. Examples of chemical treatment methods include fixation, polymerization, solidification, and stabilization.

10.6 Excavation, Treatment and Disposal Off-Site

This alternative would excavate and remove these contaminated soils for transport and disposal at an off-site facility permitted under RCRA to accept such wastes. On-site or off-site treatment of the soils may be necessary prior to off-site disposal.

Drums of contaminated soil currently on the property also would be properly disposed of off-site.

10.7 Excavation, Treatment and On-Site Disposal

Another alternative is for the contaminated soil to be excavated, treated, and then disposed of at the Apache Powder site. The contaminated soil would be: (1) removed and encapsulated in clean, low permeability clay; (2) disposed of in clay-lined cells in accordance with state environmental regulations; or (3) used as fill for existing excavations or future grading after being treated.

Detailed analyses of the retained technologies for the three soil media areas are summarized in Table 3 for the Inactive Pond Soils, in Table 4 for the White Waste Materials and Drum Storage Area, and in Table 5 for the Wash 3 Area (Excluding the Ash and Burn Area).

Table 3: **Inactive Pond soils (Metals and Nitrate Contamination)** **EPAs Preferred Alternative**

Alternative	Alternative Description	Effectiveness	Implementability	Cost (millions $)
S-1A: No Action	Status quo	Not Effective	Implementable	$0.00
S-2: Off-Site Disposal of Contaminated Soils from Pond 7 and the Dynagel Pond; On-Site Disposal of Remaining Soils in Inactive Ponds	Excavation, backfill and clay capping of all 10 inactive ponds; off-site disposal of waste materials from Pond 7 and the Dynagel Pond at a RCRA permitted treatment, storage and disposal facility	Effective; partial cleanup, but permanent; some contaminated soils remain on site; however, excavation of soils for removal may pose risk to workers	Implementable	$4.68
S-3: On-Site Disposal of All Soils in Inactive Ponds or Cells (Excavation of contaminated soils from Pond 7 and the Dynagel Pond)	Excavation, backfill and clay capping of all 10 Inactive ponds; disposal of waste materials from Pond 7 and the Dynagel Pond in a new, on-site, lined, clay capped cell	Effective; partial cleanup, but permanent; all contaminated soils remain on site; however, relocation of soils may pose risk to workers	Implementable, but difficult to meet state technical requirements	$2.59
S-4; On-Site Containment of All Soils in Inactive Ponds (No Excavation)	Backfill and clay capping of all 10 Inactive ponds, with no disturbances to contaminated soils	Effective; permanent; all contaminated soils remain on site	Implementable	$1.93

Table 4: **White Waste Material and Drum Storage Area (Nitrate Contamination and Drummed Vanadium Pentoxide)** **EPA's Preferred Alternative**

Alternative	Alternative Description	Effectiveness	Implementability	Cost (million $)
WS-1A: No Action	Status quo	Not Effective	Implementable	$0.00
WS-2: Excavation, Off-Site Disposal of Soils	Remove drums; excavation and backfill of all drummed wastes and contaminated soils, transport, treatment (fixation),and disposal at a RCRA permitted treatment, storage and disposal facility	Effective; removes all drums and contaminated soils to an off-site RCRA permitted facility	Implementable	$0.05
WS-3: Excvation, On-site Disposal of Soils	Remove drums; excavation and backfill of all drummed wastes and contaminated soils; treatment (fixation) and disposal in an on-site, unlined, clay-capped cell containing inactive pond sediments, or in a lined, clay-capped cell containing Wash 3 soils	Effective; affected area cleaned up permanently, but contaminated soils remain on site	Implementable, but difficult to meet state technical requirements	$0.02

Table 5: **Wash 3 Area(Excluding the Ash and Burn [OB/OD] Area (Lead and DNT Contamination)** **EPA'S Preferred Alternative**

Alternative	Alternative Description	Effectiveness	Implementability	Cost (million $)
W3-1A: No Action	Status quo	Not effective	Implementable	$0.00
W3-2: Excavation, Off-Site Disposal (No O&M)	Excavation and backfill of contaminated soils, transport, treatment (fixation of lead-contaminated soils; incineration of DNT-contaminated soils), and disposal at a RCRA permitted treatment, storage and disposal facility	Effective;permanent	Implementable	$0.59
W3-3: Excavation, On-Site and Off-Site Treatment and Disposal (30-year Life Cycle to Maintain Cell Cap)	Excavation and backfill of contaminated soils; on-site treatment (fixation) and disposal of lead-contaminated soils in a new, lined, clay capped cell; off-site transport, treatment (Incineration) of DNT-contaminated soils, and disposal at a RCRA permitted facility	Effective; affected area cleaned up permanently, but some materials remain on site	Implementable, but difficult to meet state technical requirements	$0.71

11.0 Summary of Comparative Analysis of Alternatives

The NCP sets forth nine criteria to be used for a detailed, comparative analysis of alternatives that have been retained after the screening portion of the Feasibility Study. The nine criteria are as follows:

- Compliance with applicable or relevant and appropriate requirements (ARARs)
- Overall protection of human health and the environment
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

A detailed analysis was presented in EPA's FS report, while a summary analyzing effectiveness, implementability, and cost was in the Proposed Plan. An analysis of the nine criteria for each of the retained alternatives is contained in Tables 6 through 10. Please refer to Section 6 of EPA's FS report, dated June 17, 1994, for additional details on the alternatives and the nine criteria, with the exception of state and community acceptance.

Table 6 - Comparison of Alternatives - Perched Groundwater

Criteria	Alt P-1A No Action (Continued Monitoring)	Alt P-2 Anaerobic Dentrification (Biological Treatment	Alt P-3 Solar Evaporation	Alt P-4 Forced Evaporation (Brine Concentrator)	Alt P-5A Reverse Osmosis (RO) (Physical Treatment)	Alt P-5B Electro-dialysis (EDR) (Physical Treatment)
Overall Protectiveness	No, existing risk remains	Yes, reduces nitrate concentrations	Yes, reduces nitrate concentrations	Yes, would reduce nitrate concentrations	Yes, would reduce nitrate concentrations	Yes, would reduce nitrate concentration
ARAR Compliance	Not applicable to No Action alternative	Yes	May not meet State aquifer protection requirements	Yes	Yes	Yes
Long-term Effectiveness	No, only natural degradation and attentuation	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would and restored and perched groundwater would no longer threaten the shallow aquifer	Yes effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer
Implementability	Yes	Yes; requires pilot studies	Yes, a simple technology that does not require pilot studies; construction of ponds may be subject to complex state technical requirements	Yes, could be implemented as part of installation of brine cooncentrator by ANP for treating process wastewaters	Yes, proven technology for TDS removal, including nitrate; pilot studies needed to set final design parameters; multiple vendors with pre-designed modules	Yes, proven technology for TDS removal including nitrate but not to the extent of RO: more extensive pilot studies than RO; limited number of vendors

Short-term Effectiveness	No Increased short-term risks	Increased short-term risks from fugitive dust and transport and handling of methanol	Increased short term risks from fugitive dust	Increased short term risk from fugitive dust and from transport and handling of acid	Increased short term risks from fugitive dust and from transport and handling of acid	Increased from fugitive dust and from transport and handling of acid

Table 6 - Comparison of Alternatives - Perched Groundwater

Criteria	Alt P-1A No Action (Continued Monitoring)	Alt P-2 Anaerobic Denitrification (Biological Treatment)	Alt P-3 Solar Evaporation	Alt P-4 Forced Evaporation (Brine Concentrator)	Alt P-5A Reverse Osmosis (RO) (Physical Treatment)	Alt P-5B Electro-dialysis (EDR) (Physical Treatment)
Overall Protectiveness	No, existing risk remains	Yes, reduces nitrate concentrations	Yes, reduces nitrate concentrations	Yes, would reduce nitrate concentrations	Yes, would reduce nitrate concentrations	Yes, would reduce nitrate concentrations
ARAR Compliance	Not applicable to No Action alternative	Yes	May not meet State aquifer protection requirements	Yes	Yes	Yes
Long-Term Effectiveness	No, only natural degradation and attentuation	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer	Yes, effective in the long-term; groundwater quality would be restored and perched groundwater would no longer threaten the shallow aquifer
Implementability	Yes	Yes; requires pilot studies	Yes, a simple technology that does not require pilot studies; construction of ponds may be subject to complex state technical requirements	Yes, could be implemented as part of installation of brine concentrator by ANP for treating process wastewaters	Yes, proven technology for TDS removal, including nitrate; pilot studies needed to set final design parameters; multiple vendors with pre-designed modules	Yes, proven technology for TDS removal, including nitrate but not to the extent of RO; more extensive pilot studies than RO; limited number of vendors

Short-term Effectiveness	No increased short-term risks	Increased short-term risk from fugitive dust and transport and handling of methanol	Increased short term risk from fugitive dust	Increased short-term risk from fugitive dust and from transport and handling of acid	Increased short-term risk from fugitive dust and from transport and handling of acid	Increased short-term risk from fugitive dust and from transport and handling of acid

Table 6 - Comparison of Alternatives - Perched Groundwater

Criteria	Alt P-1A No Action (Continued Monitoring)	Alt P-2 Anaerobic Dentrification (Biological Treatment)	Alt P-3 Solar Evaporation	Alt P-4 Forced Evaporation (Brine Concentrator)	Alt P-5A Reverse Osmosis (RO) (Physical Treatment)	Alt P-5B Electro-dialysis (EDR) (Physical Treatment)
Reduction of Toxicity, Mobility or Volume Through	No	Yes, reduces toxicity and volume of the nitrate plume; this option converts nitrate to molecular nitrogen gas, the major component of air	Yes, reduces toxicity and volume of the nitrate plume; under this option the nitrate will ultimately be part of a waste solid (a waste brine that will need to be dewatered and landfilled)	Yes, redeuces toxicity and volume of the nitrate plume; under this option the nitrate will ultimately be part of a waste solid (a waste brine that will need to be dewatered and landfilled)	Yes, reduces toxicity and volume of the nitrate plume; under this option the nitrate will ultimately be part of a waste solid (a waste brine that will need to be dewatered and landfilled)	Yes, reduces toxicity and volume of the nitrate plume; under this option the nitrate will ultimately be part of a waste solid (a waste brine that will need to be dewatered and landfilled)
Cost	$ 91,000 (Monitoring Cost for 30 Years)	$ 2,963,000	$ 3,516,000	$ 2,352,000	$ 3,492,000	$ 3,724,000
State Acceptance	The state indicated that it would not support a decision of No Action.	The State did not indicate support for this option	The State did not indicate support for this option	The State expressed support for this option, since the perched groundwater could be treated simul-taneously with the treatment of the process wastewaters	The State did not indicate support for this option	The State did not indicate support for this this option

Community Acceptance	The community expressed no interest in a No-Action remedy selection.	The community did not indicate support for this option; brine however, the community expressed strong support for immediate action to clean up the perched groundwater to implement source control	The community did not indicate support for this option	The community supported the use of the brine concentrator to clean up both the process wastewaters and the perched groundwater	The community did not indicate support for this option	The community did not indicate support for this option

Table 7 - Comparison of Alternatives - Shallow Aquifer Groundwater

Criteria	Alt GS-1A No Action (Continued Monitoring)	Alt GS-2A Anaeorbic Denitrification (In Reactor Tanks)	GS-2B Constructed Wetlands	Alt GS-3A Reverse Osmosis (RO)	Alt GS-3B Electrodialysis Reversal (EDR)
Overall Protectiveness	No, existing risk remains	Yes, reduces nitrate concentrations	Yes, reduces nitrate concentrations	Yes, reduces nitrate concentrations	Yes, reduces nitrate concentrations
ARAR Compliance	Not applicable to No Action alternative	Yes	Yes	Yes	Yes
Long-term Effectiveness	No long-term effectiveness or permanence other than natural degradation and attenuation	Yes, effective in the long-term; residual waste brine or sludge will contain less metals than RO or EDR	Yes, effective in the long-term; waste bacterial sludge will be incorporated into the wetlands system	Yes, effective in the long-term; however, concentrated waste brine containing a high concentration of metals will require removal from the system, evaporation, and disposal	Yes, enective in the long-term; however, concentrated waste brine containing a high concentration of metals will require removal from the system, evaporation, and disposal
Implementability	Yes	Yes; proven technology for nitrate conversion to nitrogen; pilot studies needed to set design parameters, including determining the viability of various bacterial strains and determining the form and quantity of carbon; multiple vendors are avalbble for detailed equipment design and procurement	Yes; would require long-term (1-2) years start-up time to establish plant species and to monitor efficiency of nitrate conversion and uptake; may be subject to complex State technical requirements for construction and siting of wetlands cells	Yes; proven technology for TDS removal including nitrate; pilot studies needed to set final design parameters; multiple vendors with pre-designed modules available; siting of evaporation ponds for waste brine may be subject to complex State technical requirements	Yes, proven technology for TDS removal including nitrate, but not to the extent of RO; pilot studies needed; limited vendors available, so less design flexibility; siting of evaporation ponds for waste brine may be subject to complex State technical requirements

Short-term Effectiveness	No increased short-term risks; avoids any evaporation loss resulting from the extraction and treatment of shallow aquifer groundwater	Potentially effective in achieving 97% nitrate destruction; potential risks from transport and handling of methanol, if used as a carbon source; potential risks from fugitive dust when excavating evaporation ponds for drying bacterial waste sludge	Provides ancillary benefits (wildlife habitat, potential recreational use, green space, protection of riparian ecosystem); takes the longest to start up (2-3 growing seasons) compared to other options; estimated 10% evaporation loss; potential risk bom fugitive dust when excavating wetland cells	Increased short-term risks from transport and handling of acid used as an anti-scalant during pilot testing and operations (risks are lower than those posed by methanol in option GS-2A) and from fugitive dust when excavating evaporation ponds for waste brine	Increased short term risks ffom transport and handling of acid used an an anti scalant during pilot testing and operations (risks are lower than those posed by methanol in option GS-2A) and from fugitive dust when excavating evaporation ponds hor waste brine

Table 7 - Comparison of Alternatives - Shallow Aquifer Groundwater

Criteria	Alt GS-1A No Action (Continued Monitoring)	Alt GS-2A Anaeorbic Denitrification (In Reactor Tanks)	GS-28 Constructed Wetlands	Alt GS-3A Reverse Osmosis(RO)	Alt GS-3B Electrodialysis Reversal (EDR)
Reduction of Toxicity, Mobility or Volume through Treatment	No	Yes, reduces the toxicity and volume of the nitrate-contaminated plume; converts the nitrate to molecular nitrogen gas, the major component of air	Yes, reduces the toxicity and volume of the nitrate-contaminated plume; converts nitrate to molecular nitrogen gas, the major component of air	Yes, reduces the toxicity and volume of the nitrate-contaminated plume; nitrate will be ultimately be part of a waste solid (a-waste brine that will need to be dewatered and landfilled)	Yes, reduces the toxicity and volume of the nitrate contaminated plume; nitrate utimately will be part of a waste solid (a waste, brine that will need to be , dewatered and landfilled)
Cost	$ 390,000 (Monitoring)	$ 17,595,000	$ 16,194,000	$ 22,654,000	$ 23,022,000
State Acceptance	The State indicated that it would not support a decision of No Action.	The State did not indicate support for this option	The State expressed support for constructed wetlands and additional evaluation of agricutural irrigation as a from of secondary treatment or as an end-use option	The State did not indicate support for this option	The State did not indicate support for this option
Community Acceptance	Some community members expressed support for no action, because of concern for too much water loss or evaporation during the extraction and treatment process;individuals wanted continued monitoring and study of the shallow aquifer to determine if natural biological degradation and attenuation would reduce nitrate levels	The community expressed some interest in this option, if it would results in less evaporation loss of the shallow aquifer groundwater than other alternatives	The community expressed some interest in this option, if the evaporation losses were not too great and if the wetlands could be made available to the public for recreational use	The community did not indicate support for this option	The community did not indicate support for this option

Table 8 - Comparison of Alternatives - Inactive Pond Soils and Sediments

Criteria	Alt S-1A No Action	Alt S-2 Excavation and Off-Site Disposal	Alt S-3 Excavation, Treatment, Containment, and On-Site Disposal	Alt Containment (Capping in Place)
Overall Protectiveness	Existing risks remain; infiltration of rain continues; may impact groundwater	Yes, remove contaminated pond soils to a regulated off-site facility; potential exposure risks during excavation and transport	Yes, controls risk of direct exposure and rainwater infiltration of cap integrity is maintained; no transport off-site; lined, on-site landfill site would be more protective than capping in-place	Yes, controls risk of direct exposure and rainwater infiltration of cap is maintained; no transport off-site or within site
ARAR Compliance	Not applicable to No Action alternative	Yes	Yes	Yes
Long-term Effectiveness	Since wastes will be left on-site, there will not be effective control to prevent contact with contamination or rain infiltration	Yes, since affected area would be cleaned up permanently	Yes, if cap integrity is maintained to prevent exposure to contaminated materials left on-site; liner provides additional long-term effectiveness over capping in-place	Yes, of cap integrity is maintained to prevent exposure to contaminated materials left on-site; long-term effectiveness considered adequate
Implementability	Yes	Yes	Yes, however may be difficult to meet state technical on site landfill disposal requirements, since contaminated materials would be excavated and moved to another location on-site	Yes, however will need to meet state aquifer protection requirements for on-site containment
Short-term Effectiveness	No increased short-term risks	Moderate increase in short-term risk due to fugitive dust during excavation and potential exposure risk during transport	Moderate increase in short-term risk due to fugitive dust and potential exposure risk during on-site transport to disposal cell no off-site transport risks	Slight increase in short-term risk due to some earthwork required while capping ponds; no major excavation or transport risks
Reduction of Toxicity, Mobility or Volume through Treatment	No	Yes, reduces mobility, volume and toxicity by removing contaminants to an off-site regulated facility for treatment and disposal	Reduces mobility since capping will reduce rainwater infiltration and liner will prevent further contaminant migration; no reduction of volume or toxicity of contaminated soils	Reduces mobility since capping will reduce rainwater infiltration; no reduction of volume or toxicity of contaminated soils

Cost	$ 0	$ 4,678,000	$ 2,590,000	$ 1,926,000
State Acceptance	The State indicated that it would no support a decision, of No Action	The State has expressed its support for off-site treatment and disposal but also considers options S-3 and S-4 to be protective and not as costly	The State has expressed certain reseverations about excavation and redisposal of the contaminants on-site because of the State landfill requirements	The State has expressed its support for this option, assuming that the capping is consistent with State aquifer protection requirements
Community Acceptance	The community has expressed no interest in a No-Action remedy selection.	The community wants the ponds closes and cleaned upo, but did not state a specific opinion on whether the ponds soils needed to be removed off-site for treatment and disposal	The community wants the ponds closed and cleaned up, but did not state a specific opinion on the method; one general comment was that they did not want the contamination just moved from one place to another without sufficient monitoring	The community seemed to support this option; the community's primary concern is that the ponds are closed and cleaned up; no one opposed capping the contaminated soils in-place

Table 9 - Comparison of Alternatives - White Waste Materials and Drum Storage Area

Criteria	Alt WS-1A No Action	Alt WS-2 Excavation and Off-Site Disposal	Alt WS-3 Excavation and On-Site Disposal
Overall Protectivenss	No, existing risks remain; infiltration of rainwater continues and may impact groundwater	Yes, removes all contaminated soils from the area to a regulated off-site facility; potential moderate risks during excavation and off-site transport	Yes, existing risk due to direct exposure is controlled, if integrity of cap is maintained; rainwater infiltration is controlled; no off-site transport risks
ARAR Compliance	Not applicable to No Action alternative	Yes	Yes
Long-term Effectiveness	Since wastes will be left on-site, there will not be effective control to prevent contact with contamination	Yes, since affected area would be cleaned up permanently	Yes, if cap integrity is maintained to prevent exposure to contamination however will require continual monitoring
Implementability	Yes	Yes	Yes, but requires more effort to meet state technical requirements for on-site landfill than WS-2
Short-term Effectiveness	No increase in short-term risks	Potential exposure to fugitive dists during excavation; also potential exposure risks during off-site transport	Potential exposure to fugitive dusts, but no off-dite transport risks
Reduction of Toxicity, Mobility or Volume through Treament	No	Reduces mobility, volume and toxicity in the affected area by removal of the contaminants to an off-site regulated facility for treatment and disposal	Reduces mobility, and could reduce some volume and toxicity of during excavation, hot spots are discovered and treated on-site
Cost	$ 0	$ 51,000	$ 19,000
State Acceptance	The State indicated that it would not support a decision of No Action.	The State supports WS-2, since this option provides a permanent remedy without substantial Cost	The State would support this option, but has concerns about options meeting state technical requirements for an on-site landfill

Community Acceptance	The community has expressed no interest in a No-Action remedy selection.	The community wants the contamination removed and cleaned up	The community wants the contamination removed and cleaned up, but has not expressed specific requirements on whether off-site disposal

Table 10 - Comparison of Alternatives - Wash 3 Area (Excluding the Ash and Burn Area)

Criteria	Alt W3-1A No Action	Alt W3-2 Excavation and Off-Site Disposal	Alt W3-3 Excavation and On-site Disposal
Overall Protectiveness	No, existing risks remain; infiltration of rain continues and may impact groundwater	Yes, removes all contaminated soils from area to a regulated off-site facility for treatment and disposal; potential risks during transport	Yes, existing risk due to direct exposure is controlled, if cap integrity is maintained; rainwater infiltration is controlled; no off-site risks
ARAR Compliance	Not applicable to No Action alternative	Yes, would meet action-specific and location-specific ARARs; however, no chemical-specific ARARs for soils were identified	Yes, would meet action specific and location specific ARARs; however, no chemical specific ARARs for soils were identified
Long-term Effectiveness	No long term effectiveness or permanence, since contaminants will be left on-site with no effective control to prevent contact	Yes, since affected area will be cleaned up permanently	Yes, so long as cap integrity is maintained to prevent exposure to contamination
Implementability	Yes	Yes	Yes
Short-term Effectiveness	No increased short-term risks	Potential exposure to fugitive dust and community exposure to transport risks	Potential exposure to fugitive dust, but no off-site transport risks
Reduction of Toxicity, Mobility or Volume through Treatment	No	Reduces mobility; reduces volume and potential toxicity by removing the contaminants to an off-site regulated facility for treatment and disposal	Reduces mobility; if hot spots are treated on-site or removed off-site, may reduce some volume and toxicity
Cost	$ 0	$ 591,000	$ 716,000
State Acceptance	The State indicated that it would not support a decision of No Action	The State supports W3-3, since this option provides a permanent remedy	The State would support this option, but has concerns about option meeting state technical requirements for an on-site landfill
Community Acceptance	The community has expressed no interest in a No-Action remedy selection	The community wants the contamination cleaned up; no negative comments have been received on this option	The community wants the contamination cleaned up, but has expressed no specific opinions on how this should be done

12.0 The Selected Remedy

Based upon evaluation of the CERCLA requirements, the detailed analysis of the alternatives using the nine criteria, and public comments, EPA has determined that the five selected alternatives indicated on Table 13 are the most appropriate remedies for the Apache Powder Site. The selected remedies will clean up the nitrate-contamination in the perched groundwater zone and the shallow aquifer and provide several different cleanup measures for the soils contamination. The selected remedy for the contaminated soils left on-site will provide a permanent barrier to the contaminated soil and prevent rainwater from infiltrating the contaminated soils and carrying the contamination to groundwater. The selected remedy for the contaminated soils and drummed material selected for off-site treatment and disposal wlil permanently remove the contamination from the site and treat and dispose of the contamination at a permitted facility.

The selected remedy is protective, meets ARARs, is effective for the long-term, and is permanent. With the exception of the contaminated soils in the inactive evaporation ponds, the selected remedy for each of the other four media areas meets the statutory preference for treatment. The selected remedies for the two groundwater media areas and the on-site clay-capping of the contamination in the inactive ponds can be constructed, with readily available materials and common construction techniques. Thus, they are considered implementable. Short-term risks to workers will be slightly elevated during the capping of the inactive ponds, but measures will be taken to minimize the impacts. Since the cap will have a permeability of less than 1 x 10-6 cm/sec, groundwater will be protected, thus further reducing the risks posed by the site.

The selected remedy for each of the five media areas is cost-effective.

The State of Arizona concurs with EPA's selected remedies.

During the design process, groundwater analyses will be performed to ensure that the extraction and treatment of the contaminated shallow aquifer does not unduly interfere or diminish the existing water resources. Also, the community will have the opportunity to participate during the selection of the type and final siting of the constructed wetlands and the recharge phase of treatment of shallow aquifer groundwater. Fact sheets will be distributed periodically during the remedial design phase to keep the community informed during the remedial design phase.

The following are the key components of the selected remedy:

GROUNDWATER

- Installing additional groundwater monitor wells to determine the lateral extent of nitrate contamination in the shallow aquifer and the perched zone

- Conducting a monitoring program to collect chemical water quality data and water levels

- Conducting aquifer tests and groundwater modeling to ascertain what potential impacts, if any, pumping will have on downstream water users

- Extracting and treating the perched groundwater by forced evaporation (brine concentrator), in conjunction with treatment of the company's process wastewaters, to meet the federal and state drinking water standard of 10 parts per million (ppm) for nitrate. (Figure 4)

- Extracting and treating the shallow aquifer by use of constructed wetlands to meet the federal and state drinking water standard of 10 parts per million (ppm) for nitrate, and recharging the treated water through wetlands, agricultural irrigation, discharge or some combination of methods as determined during Remedial Design (Figures 5A and 5B)

- Monitoring long-term effectiveness and permanence;

- Replacement of contaminated shallow aquifer domestic wells with deep aquifer wells

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SOILS

- Excavating designated areas to clean-up standards (Table 12);

- Consolidating and transporting excavated materials to an off-site permitted facility for treatment and disposal;

- Constructing a low permeability clay cap over the contaminated soils in the inactive evaporation ponds;

- Monitoring the clay cap on at least an annual basis to ensure that the integrity of the cap is maintained and that the ponds to not act as continuing sources of groundwater contamination; and

- Implementing institutional controls so that future use of the site is compatible with the remedial goals and maintaining the protection provided by the clay caps

12.1 Clean-up Standards

GROUNDWATER

The chemicals of concern for groundwater are arsenic, fluoride, and nitrate in the perched groundwater zone. Nitrate is the only contaminant of concern in the shallow aquifer. Federal and State MCLs, which are the same for these contaminants, are ARARs for groundwater. Table 11 presents the background levels, Preliminary Remediation Goals (PRGs), Arizona's Health Based Guidance Levels (HBGLs), site-derived, risk-based levels, and drinking water MCLs for the chemicals of concern in groundwater. EPA's selected clean-up standards are presented in the last column.

ALTERNATIVE WATER SUPPLY

As discussed in section 4.0, interim actions have been taken to address potential threats to public health from the domestic use of contaminated groundwater. The selected remedy requires the provision of an alternative water supply and other measures as necessary to prevent the domestic use of nitrate-contaminated shallow aquifer groundwater:

1. An alternative water supply in the form of the deep aquifer replacement wells will be supplied to the households that meet the criteria of the Alternate Domestic Water Supply Plan ("ADWSP") approved by EPA in April 1994.

2. Identifying the lateral extent of the nitrate-contaminated plume during the first phases of remedial design will provide the basis for notice of areas of known shallow aquifer nitrate contamination. (At a minimum, an accurate plume map will be placed in the site repository at the Benson Library.)

3. The existing inventory of private wells in the vicinity of the plume will be updated periodically. Any identified private wells threatened or potentially affected by the plume, and without sufficient monitoring data, initially will be monitored quarterly.

4. An alternative water supply in a form to be approved by EPA will be provided to additional households if the household relies on a shallow aquifer well for domestic water and the water from the well exceeds the federal drinking water standard of 10 ppm for nitrate in three consecutive quarters of sampling. (EPA may require an alternative water supply immediately if level of nitrate significantly exceed the federal drinking water standard.)

Table 11

Preliminary Remediation Goals (PRGs), Background Levels, Arizona Health Based Guidance Levels (HBGLs), Site-Derived, Risk-Based Levels, and Arizona Department of Water Quality (ADEQ) Water Quality Standards and Selected Clean-Up Standards for Chemicals of Concern in Groundwater at the Apache Powder Site

Media of Concern	Chemical	Background(a)	Region IX PRGs	HBGLs	Site-Derived Risked-based Level(b)	ADEQ Water Quality Standards (Federal MCL)	Selected Clean-Up Standards
		mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
Perched Groundwater	Arsenic	0.00537	0.000049	0.00002	0.14(c)	0.05	0.05
	Fluoride	1.4	2.2	0.042	0.38(c)	4.0	4.0
	Nitrate as nitrogen	0.22	58.0	11.0	6.5(c)	10.0	10.0
Shallow Aquifer Groundwater	Arsenic	0.00537	0.000049	0.00002	0.14(c)	0.05	0.05
	Fluoride	1.4		0.420		4.0	4.0
	Nitrate as nitrogen	0.22		11.0		10.0	10.0

Footnotes:

(a) Arithmetic mean derived from Remedial Investigation (RI) background samples.
(b) Based on acceptable cancer risk being 1.OE-06 and acceptable non-cancer hazard being 1.0.
(c) Off-site resident infant.

Table 11. EPA's Selected Clean-up Standards for Groundwater

Table 12

Preliminary Remediation Goals (PRGs), Background Levels, Arizona Health Based Guidance Levels (HBGLs), Site-Derived, Risk-Based Levels, Arizona Hazardous Waste Management Act (HWMA) Treatment Standards, and Selected Cleanup Standards for Chemicals of Concern in Soils at the Apache Powder Site

Media of Concern	Chemical	Back-ground(a)	Region IX PRGs	HBGLs	Arizona HWMA Treatment Standards	Site-Derived Risked-based Level(b)	Selected Clean-up Standards
		mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
Inactive Pond	Antimony	4.47	11.0	47.0		38.2(c)	Capped in
Soils and	Arsenic	12 02	0.97ca/23nc	0.76		25.8(c)	place
Sediments	Barium	125.7	5.500	8,200		1,200(c)	
	Beryllium	0.94	0.4	0.32		513(c)	
	Chromium total	9.78	940.0	1.700		3.83(c)	
	Lead Manganese	14.27	500.0	500.0		NC	
	Nitrate as nitrogen	383.0	390.0	580.0		1,110(c)	
		140.05	100,000	190.000		84,500	
White Waste	Nitrate as nitrogen	140.05	100,000	190,000		84,500	190,000
Materials and	Vanadium	16.37	550.0	820.0		753.0(c)	820.0
Drum Storage Area	Vanadium pentoxide	NC	690.0	1,100.0		NC	1,100.0
Wash 3	2,4-Dinitrotoluene (DNT)	0.0(d)	1.3	2.0	140.0	NC	140.0
(Excluding the	2,6-DNT	0.0(d)	1.3	120.0	28	NC	28.0
Ash and Bum	Paraffins	0.0(d)	NC	NC	NC	0.0	
Area)	Lead	14.27	500.0	500.0	NC	500.0	

Table 12. EPA's Selected Clean-up Standards for Soils

SOILS

Where no ARARs were identified for soils, the cleanup standards for excavation are based upon health-based levels. Site-Derived, Risk-Based Levels were established by calculating the chemical concentrations in soil and groundwater that correspond either to an excess cancer risk of 1.0 x 10-6 or a hazard index of 1.0, based on the results of the risk assessment. EPA's PRGs were developed to be used as a rapid reference for screening concentrations in environmental media and as initial cleanup goals. Arizona's HBGLs for the Ingestion of Contaminants in Soils also were established as potential cleanup levels and to establish a benchmark for taking additional action. Table 12 presents the background levels, PRGs, HBGLs, risk-based levels, and Arizona's Hazardous Waste Management Act (HWMA) treatment standards for the chemicals in soil. EPA's selected clean-up standards are presented in the last column. In the absence of an established ARAR, the selected soil clean-up standard for each compound is the Arizona HBGL.

12.2 Remedial Design (RD) Characterization and Analysis

GROUNDWATER

The Feasibility Study (FS) report and the Proposed Plan recommended additional groundwater investigation and modeling during the first part of the remedial design (RD). The purpose of these studies would be to define the lateral extent of nitrate contamination in the perched groundwater zone and the shallow aquifer, and the effect of various extraction rates on the shallow aquifer's water balance.

Perched Groundwater Zone

Further delineation of the perched groundwater zone will be conducted to the extent that additional data is needed to assist in locating extraction wells and determining pumping rates. Because source control is the highest priority requirement for groundwater protection, emphasis will be placed on gathering this data and proceeding with the maximum volume of pumping that can be managed by the brine concentrator as soon as it is on-line in the spring of 1995.

Shallow Aquifer

The FS report also recommended additional groundwater characterization and analysis to support the design of the shallow aquifer groundwater extraction and treatment system. Based on data available during the FS, EPA relied on the assumption that 720 gallons per minute (gpm) would be the required pump rate for treating the shallow aquifer within a 12 year time-frame, an assumption developed by Hargis & Associates (H+A) for ANP. However, short term (e.g., less than one year) aquifer testing and water modeling studies wi'l be completed to determine the impact of varying pump rates on the water levels in the shallow aquifer and on the San Pedro River and to gather the appropriate data necessary for designing the well extraction system. Also, additional monitoring wells also will be installed in the northwestern portion of the nitrate plume to define the lateral extent of contamination.

The results of these groundwater studies, to be completed early in the RD, will be shared with the community through fact sheets and/or community meetings prior to commencing the final design plans for the extraction system. Treatability studies also will be conducted for constructed wetlands (and, if appropriate, for secondary treatment options discussed below) to determine their denitrification and/or nitrate uptake capacities for high nitrate concentrations (300 ppm). The results of the groundwater modeling will be evaluated to determine if reduced pumping rates and/or selected "hot-spot" pumping may be necessary to ensure minimal impact on water resources and the riparian resources of the San Pedro River.

During the public comment period, some members of the community raised concerns that the use of constructed wetlands to treat the nitrate-contaminated groundwater in the shallow aquifer could result in potential evaporation/transpiration loss of valuable water needed for crop irrigation. A proposal was presented to use agricultural irrigation as a method for reducing the nitrate levels in the groundwater rather than other treatment alternatives. EPA initially screened out this alternative primarily because the ANP facility had insufficient land space suitable for growing agricultural crops. However, the comments recommended using privately-held farm lands in the vicinity of the ANP site. (See the Responsiveness Summary, Part 111 of this ROD, for EPA's analysis of this proposal.) While EPA is selecting constructed wetlands as the primary treatment method, EPA will evaluate during RD, a variety of secondary treatment recharge options, including habitat wetlands, agricultural irrigation, discharge to the San Pedro River, or some combination of these.

SOILS

Inactive Ponds

Extensive sampling is not expected to be necessary during RD. However, a limited amount of characterization sampling will be required to determine whether soils in or around the inactive ponds require excavation or removal prior to being capped. If chemicals of concern not previously identified are detected in or around any of the inactive ponds, the conceptual approach for cleanup of these ponds may need to be revised. The development of a sampling plan and the completion of this sampling effort will be completed during the first phase of RD.

White Waste Materials and Drum Storage Area

EPA, in consultation with the State, has determined that the White Waste Materials and Drum Storage Area will be cleaned up in conjunction with this CERCLA remedial action for remediation of the historical contamination problems at the site. The State does not intend to include this area under the State Consent Decree for cleanup of the active waste management areas of the facility. Final cleanup and confirmatory sampling will be conducted by ANP as part of EPA's selected CERCLA remedy, not under the State's Consent Decree.

Wash 3 Area (Excluding Ash and Bum Area)

As in the case of the White Waste Materials and Drum Storage area, the State does not intend to include the Wash 3 Area under the State Consent Decree for cleanup of the active waste management areas of the facility. With the exception of the area immediately adjacent to the Ash and Burn Area (also known as the Open Burn/Open Detonation (OB/OD) which is covered under the jurisdiction of the State's RCRA interim-status closure requirements, the Wash 3 area will be characterized for final cleanup and confirmatory sampling as part of EPA's selected CERCLA remedy. Additional confirmatory sampling will be required both in the area where the contaminated soils have been stored and in the previously excavated areas prior to final approval of the completed remedial action.

12.3 Institutional Controls

There will be restrictions on the ANP site to prohibit shallow aquifer groundwater use for drinking purposes.

There will be restrictions on the uses of the capped areas of the site. Only those uses that will not adversely affect the cap will be allowed, in order to maintain the integrity of the caps. Some of the uses that may be compatible with the caps include recreation (e.g., picnic areas) and light storage. Uses that are unlikely to be compatible include heavy equipment storage, enclosed buildings, and any structure that would compromise the integrity of the clay cap during construction.

12.4 Annual Inspection

All components of the remedy will be inspected and evaluated not less than annually. Special circumstances (such as heavy rains) may require additional inspections. Groundwater monitoring will be conducted not less than quarterly. The site will also be inspected to verify the integrity of the clay caps on the inactive ponds, and that institutional controls are maintained. Operation and maintenance will be conducted to ensure that the remedy maintains its effectiveness.

12.5 Monitoring - Groundwater

Groundwater monitoring will be conducted throughout both the design and the implementation of the remedy for several purposes:

1. To assess the effects of groundwater extraction and pumping on the shallow aquifer and the baseflow of the San Pedro River.

2. To assess the effectiveness of groundwater recharge through constructed wetlands and/or agricultural irrigation.

3. To monitor the effciency of the treatment process(es) (e.g., influent, effluent, intermediate points) to meet and comply with the treatment standards established in this ROD.

12.6 Cost

A detailed cost description of each of the components of the preferred remedy for each of the five media area is included in Appendix E of the FS report. The estimated cost for the selected remedy is shown in Table 13 as a present worth value, and includes annual monitoring for 30 years and appropriate 5-year reviews.

TABLE 13 Alternative 1 Site-Wide Costs - Forced Evaporation (Perched), Constructed Wetlands (Shallow Aquifer), On-Site Capping of Inactive Ponds and Off-Site Fixation/Incineration for Soils

Media	Alternative Selected	Description of Action	Cost ($ millions)
Groundwater			
Perched Groundwater	P-4	Forced evaporation	$ 2.35 M
Shallow Aquifer	GS-2B	Constructed wetlands	$ 16.19M
Soils			
Inactive Ponds Soils and Sediments	S-4	Contamination; Backfill and clay cap	$ 1.93 M
White Waste Material and Drum Storage Area	WS-2	Excavation and backfill; off-site transport to a permitted facility for fixation and disposal	$ 0.05 M
Wash 3 Area (excluding Ash and Bum Area)	W3-2	Excavation and backfill; off-site transport to a permitted facility for fixation / incineration and disposal	$ 0.59 M
Total Cost			$ 21.11 M

Table 13. Cost of the Selected Remedy

12.7 Summary of Major Community and State Concerns

Concerns raised by the community and the State have been addressed and evaluated. EPA's response to these concerns is contained in Part 111 of the Record of Decision (Responsiveness Summary)

Based on community concerns that the shallow aquifer groundwater might be subject to excessive evaporation loss if treated solely by constructed wetlands, and a desire to use the extracted water prior to recharge, a preference was expressed by some for agricultural irrigation rather than constructed wetlands as a treatment option To address this preference, EPA will consider, during Remedial Design, agricultural irrigation and other recharge/end use options for the shallow aquifer groundwater

Additional comments were submitted regarding siting of the secondary stage, recharge or habitat wetlands away from the ANP operating facility so that the public could visit the wetlands for recreational or educational purposes without potential exposure to the day-to-day manufacturing operations at the ANP facility. Decisions on the final siting of the recharge or habitat wetlands and the potential use of agricultural irrigation as a component of the secondary stage treatment/recharge will be made during the remedial design, after additional data collection, characterization, and analyses.

Members of the community and various state agencies also commented on the importance of protecting the water resource of the San Pedro River Basin both to protect riparian resources and to provide sufficient water for downstream users. Particular interest was expressed in the impact that the extraction and treatment process, including the rate of recharge, will have on the water level in the shallow aquifer. EPA agrees that additional studies will need to be conducted during the remedial design to minimize any potential impacts on the water levels.

Other members of the community commented that it was inequitable to install deep aquifer replacement wells for those households that had been on bottled water and not to provide some compensation for those landowners who already had installed deep aquifer wells at their own expense or who had not yet installed wells because of the shallow aquifer contamination. Comments were also submitted that well owners with deep aquifer wells would incur increased utility and pumping costs, because of additional water demands on the deep aquifer. In order to avoid drilling new deep aquifer wells, a few comments suggested extending the St. David water supply system to accommodate new residents in the area of contaminated groundwater.

To resolve these issues, discussions should be held among landowners, ANP, and local officials, including the St. David water supply system officials. EPA will, to the extent practicable, facilitate such discussions and perform other actions as necessary to protect public health. See Part III (Responsiveness Summary) for a more detailed discussion of these issues.

13.0 Statutory Determinations

13.1 Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment. The potential for direct contact with contaminated groundwater and soil will be reduced significantly by the following mechanisms.

GROUNDWATER

Pumping and treating the perched groundwater by forced evaporation (with a brine concentrator) and the shallow aquifer by constructed wetlands will greatly reduce nitrate levels, thereby reducing potential exposures to nitrate via groundwater and/or surface water. Replacement of the nitrate-contaminated shallow aquifer domestic wells will provide significant further reduction in the potential for nitrate exposure.

SOILS

The potential for direct contact with contaminated soils will be greatly reduced by excavating and removing contaminated soils for off-site transport, treatment, and disposal at a RCRA permitted facility, and by backfilling the on-site inactive ponds and covering them with a clay cap. The cap will also reduce significantly the potential for rainwater to leach contaminants from the soil into a perched groundwater zone and potentially to the shallow aquifer.

Permanent restrictions will be in place to notify on-site workers and future land owners of the extent and risks of residual contamination. The restrictions placed on the ANP property will prevent inadvertent contact with contaminated soils. The restrictions also will ensure that the integrity of the capping is maintained to effectively contain the contaminated soils. There are some short-term risks to on-site workers associated with the inactive ponds while the capping is performed. However, dust suppression measures will be required to minimize the risk.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The selected remedies will comply with all ARARs. The chemical-specific ARARs for the groundwater cleanup are listed in Table 11. The action-specific and location-specific ARARs for the selected remedies are attached as Appendix A.

13.3 Cost-Effectiveness

EPA believes this remedy will significantly reduce the risks at this site by eliminating the pathway for direct contact with nitrate-contaminated groundwater and contaminated soil. This will be done at an estimated cost of $18.5 million for the groundwater and $2.6 million for the soils, for a total cost of $21.2 million, which EPA considers commensurate with the risk reduction that will be achieved.

13.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and alternative treatment technologies (or resource recovery) to the maximum extent practicable. The principal threats of the site, the contaminated groundwater and the soils contamination, will be treated with one exception. One soils area, the Inactive Pond Soils and Sediments, was evaluated in the FS and screened out for treatment because it was not found to be practicable to remove relatively low levels of metal contaminated pond sediments which were relatively immobile (binding to the soil particles) and were at extremely low level of risk of transport into the underlying groundwater, if capped in place.

The components of EPA's selected remedy consists of proven technologies, common construction materials and practices, and incorporates EPA's guidance for closing surface impoundments to provide a protective, permanent solution to the site problems.

13.5 Preference for Treatment as a Principle Element

It was determined that treatment of the principal threats of the site was practicable for the site, with the exception of the soils and sediments located in the inactive ponds area, as discussed above under Section 12.4.

14.0 Documentation of Significant Changes

There are no significant changes from the Proposed Plan to the Record of Decision. The Proposed Plan for the Apache Powder Superfund site was released for public comment on June 23, 1994. EPA has reviewed all written and verbal comments submitted during the public comment period, and has selected remedies for the five media areas as conceptually presented in the Proposed Plan. One minor change relates to the treatment of the shallow aquifer groundwater. While EPA is selecting constructed wetlands as the primary treatment, EPA additionally will evaluate during remedial design other recharge/end use options. The other four media areas of the selected remedy have not changed.

PART III: RESPONSIVENESS SUMMARY

1.0 Overview

On June 22, 1994, the U.S. Environmental Protection Agency (EPA) issued a Proposed Plan stating EPA's preference for the cleanup alternatives for the Apache Powder Superfund Site in St. David, Arizona. A thirty-day public comment period, following the issuance of the Proposed Plan, ended on July 25, 1994. At a public meeting held on July 6, 1994, EPA presented the alternatives for addressing the groundwater and soils contamination at the Site, described EPA's preferred alternatives and answered community questions. This Responsiveness Summary is a written summary of the significant comments received by EPA during the public comment period and EPA's responses to these comments.

After consideration of the public comments and review of the administrative record, EPA has selected as the remedy the alternatives identified in the Proposed Plan. This remedy is embodied and described fully in Parts I and II of the Record of Decision (ROD). In short, the remedy calls for extraction and treatment of perched water by a brine concentrator[1]; extraction and treatment through constructed wetlands of the nitrate-contaminated shallow aquifer groundwater; and a variety of on-site and off-site cleanup methods for the soils.

The community's response to the Proposed Plan, described more fully in section 4.0 below, was generally favorable. The community clearly wants cleanup to proceed, and had little comment on the perched groundwater and soils alternatives. Most of the community's comments centered on the use of constructed wetlands for treating the shallow aquifer groundwater. One area of concern was the potential loss of water, leading to suggestions of other alternatives, such as agricultural irrigation or deferment of the shallow aquifer cleanup.

The comments by state agencies and by Apache Nitrogen Products, Inc. (ANP), the owner and operator of the Apache site, are discussed in section 5.0 below. The state generally concurs with EPA's remedy selection. ANP generally supports the perched groundwater and soils remedies with modifications. ANP favors cleanup of the shallow aquifer but suggests a lower, more selective pumping rate. ANP prefers the treatment alternative of constructed wetlands to the other alternatives discussed in the Feasibility Study but urges EPA to consider other treatment methods, such as agricultural irrigation.

1 Apache Nitrogen Products, Inc. (ANP) currently is constructing a brine concentrator to treat its industrial process wastewater. The perched water is similar enough, to ANP's process wastewater to make treatment with the same equipment feasible.

2.0 History of Community Involvement

EPA has conducted an extensive outreach program to involve the community in activities at the site. For a detailed description of community involvement, refer to section 5.0 of Part II of the ROD.

3.0 Organization of Responsiveness Summary

3.1 Community Concerns on Major Issues

The community expressed its concerns about the cleanup of the Apache Powder Site in two principal ways. Many in the community attended and spoke at the public meeting on the proposed plan held on July 6, 1994. Other community members submitted written comments to EPA. EPA acknowledges and appreciates the thoughtful input of the local community, the State, and ANP.

Several major issues were raised by the community during the public comment period. A summary of those issues and EPA's responses are presented in section 4.0. Section 4.0 responds to the letters submitted by community members and the comments made at the public meeting. These letters and comments cover a range of issues but with much overlap. For ease of responding, EPA grouped these community concerns into six general subject matter categories. Responses to more specific or technical comments appear in section 5.0.

EPA is not repeating in this Responsiveness Summary all questions and answers from the public meeting. A copy of the meeting transcript is included in the Administrative Record and is available at the public repository in the Benson Library.

3.2 Comment Letters Received

In addition to the comments received during the public meeting, EPA received and considered the following comment letters, a few of which arrived after the July 25, 1994 close of the comment period.

- Arizona Department of Environmental Quality, July 25, 2994
- Arizona Department of Environmental Quality, August 11, 1994
- Arizona Department of Water Resources, July 25, 1994
- State of Arizona Office of the Attorney General, July 25, 1994
- Kimball & Curry, P.C., on behalf of Apache Nitrogen Products, Inc., July 25, 1994
- Julie Stromberg, Ph.D., Arizona State University, Center for Environmental Studies, June 16, 1994
- Dick Kamp, Border Ecology Project, July 6, 1994
- Gladys Garno, St. David, Arizona, June 15, 1994
- John S. Gay, Sahuarita, Arizona, July 5, 1994
- Mike Kruse, Phoenix, Arizona, July 6, 1994
- John S. Gay, Sahuarita, Arizona, July 11, 1994
- Lawrence J. and Patty J. Saunders, St. David, Arizona, July 11, 1994
- Gerald J. and Farrel H. Kempton, St. David, Arizona, July 20, 1994
- Thomas Haymore, St. David, Arizona, August 1, 1994

Copies of all written comments are in the Administrative Record and will be available at the public repository in the Benson Library.

4.0 Summary of Responses to Major Issues and Concerns

In addition to comments received on EPA's selected remedies for the areas of historical contamination at the ANP site, EPA received comments on air emissions and other State issues. Because of previous agreements between EPA and the State on the division of responsibilities for oversight and enforcement of cleanup activities at the site, EPA forwarded comments relating to State issues to ADEQ.

4.1 Health Concerns and Site Risks

Groundwater

The potential health threat of nitrate in drinking water is one of the main concerns posed by the nitrate-contaminated shallow aquifer groundwater plume migrating from the Apache Powder site. The ongoing discharge of process wastewaters to the perched groundwater underneath the evaporation ponds has resulted in continual contamination of the shallow aquifer. The installation of the brine concentrator (scheduled for April 1995) will halt this continuing discharge to the perched groundwater, since the wastewaters will be treated and recycled for reuse. Additionally, once the brine concentrator is on-line, the perched groundwater will be extracted and treated by the brine concentrator, along with the process wastewaters.

The extraction and treatment of the shallow aquifer will begin to clean up the nitrate contamination over a period of years. In the interim, bottled water has been supplied to residents to avoid the potential risk of drinking nitrate-contaminated water above the federal Maximum Contaminant Level (MCL) of 10 milligrams per liter (mg/l) or 10 parts per million (ppm). Currently, ANP is installing new deep aquifer replacement wells under the Alternative Drinking Water Supply Plan (ADWSP), which is being incorporated as part of this record of decision.

However, a potential risk continues to exist for new residents in the area who unknowingly may install drinking water wells into the shallow aquifer and potentially be exposed to nitrate. EPA considers the groundwater contamination at the site to be a potential health threat, which must be cleaned up to protect human health. EPA will explore avenues for ensuring that, until the nitrate level in the shallow aquifer groundwater is reduced to below the MCL, future residents are aware of the risks of exposure to shallow aquifer groundwater.

Soils

Currently, the site is fenced. Contaminated soils do not pose an immediate risk, with the possible exception of risk to trespassers who are not knowledgeable of the on-site areas where hazardous substances are stored or contained. Trespassers could be exposed to some of the surface soil contamination that exists on the site. Another potential health risk via the soils pathway exists for on-site workers and nearby residents, if the site were opened up for development. If contaminated soils were moved or disturbed in the future during the course of remedial activities, digging the foundations for buildings, or clearing site areas for construction, disturbed soil could be released to the atmosphere, greatly increasing the chances for human exposure. EPA considers the soil contamination at the site a potential health threat requiring either removal or containment, based on assumptions made for future use of the site.

In order to protect the health of the community, the pathway through which the population can be exposed must be eliminated. EPA has chosen a combination of methods for protecting people from the contaminated soils, both on-site containment and off-site treatment and disposal. The metal-contaminated soils and sediments in the inactive ponds will be covered in place with a low-permeability clay cap and will remain on site. The clay cap will be a physical barrier between people and the contaminated soils. Institutional controls (e.g., deed restrictions) may be put in place to ensure that future use of the inactive ponds area is compatible with the remedial goals and to maintain the integrity of the clay caps. The remaining contaminated soils, currently located in the White Waste Material and Drum Storage Area and in the Wash 3 Area, will be excavated and removed to an off-site permitted hazardous waste facility for treatment and disposal.

4.2 Water Resources - Agricultural Irrigation

A major concern of the community is whether the use of constructed wetlands to treat the shallow aquifer adequately considers the unique water resource constraints on this arid part of the southeastern Arizona. Several comments, including comments from the Arizona Department of Environmental Quality and ANP, recommended that consideration be given to agricultural irrigation as either a secondary treatment alternative or for end use.

An irrigation proposal was presented by a member of the agricultural community, identifying owners of approximately 1,000 acres of privately-owned land adjacent to the ANP site who would be interested in taking the nitrate-contaminated water for crop irrigation. The identified 1,000 acres were on both the east and the west side of the San Pedro River. To date, the contaminated nitrate plume has only been detected on the west side of the river, with the exception of a small area near the Pomerene Canal north of site. Only low levels of nitrate contamination (3-5 ppm) in the range normally expected in an agricultural area have been detected on the east side of the river. For this reason, EPA believes consideration of agricultural irrigation should be limited to the west side of the river to eliminate any potential risk of introducing levels of nitrate above the federal Maximum Contaminant Level (MCL) of 10 ppm and the consequent risk of contaminating any drinking water wells.

EPA agrees that the agricultural irrigation concept should be evaluated during the first phase of remedial design (RD). EPA plans to include several studies, including but not limited to gathering data on the concentrations of nitrate in various portions of the plume, water balance, the potential land acreage both on and off the ANP site, the geological characteristics of the areas considered for irrigation (clay versus alluvium), the crops available for irrigation, and the efficiency of these crops to take up nitrate. Based on the findings of these studies, it may be feasible to incorporate the use of agricultural irrigation either as secondary treatment following primary treatment in a constructed wetlands or as an end use if the influent levels of nitrate can be reduced to levels that can be efficiently treated by the crops. However, until these studies are completed, EPA believes it is premature to alter the selection of constructed wetlands for treatment of the nitrate in the shallow aquifer.

In conversation, some members of the agricultural community have expressed an interest in developing educational programs in the use of constructed wetlands and/or crop irrigation to inform the community on environmental protection and enhancement and good farming/ranching management practices.

4.3 Water Resources - Riparian Protection

Many members of the community and various state agencies commented on the importance of protecting the water resources of the San Pedro River Basin, and to maintain or, if possible, enhance the riparian resources. Concerns were raised that extracting and pumping the shallow aquifer groundwater to treat and remove the nitrate may potentially damage these ecological resources.

EPA concurs and has determined that various types of hydrogeological studies should be conducted during RD to evaluate the hydraulic connection between the shallow aquifer and the San Pedro River. These studies include, but are not limited to, aquifer testing, updated water quality testing, and groundwater modeling. In addition, refinement of the assumptions on pumping rates and the location of extraction wells will be developed during RD to minimize any impact on the flow of the San Pedro River. Water levels also will be monitored during operations so that adjustments to the pumping rates can be made, as necessary. EPA also will consider measures during RD for enhancing existing riparian resources by careful consideration of the siting and construction design (including choice of vegetation) for the constructed wetlands.

4.4 Water Resources - Downstream Users

Other members of the community commented that pumping and extracting the groundwater from the shallow aquifer for treatment by constructed wetlands may continue to exacerbate an already lowered water table. As stated above, EPA concurs that additional studies need to be conducted during the first phase of RD to minimize any impact on the San Pedro River Basin and the availability of water for downstream users. EPA will ensure that the RD will effectively address recharge to the shallow aquifer groundwater.

4.5 Water Resources - Deep Aquifer Replacement Wells

Some members of the community commented that it was inequitable to install deep replacement wells for households that had been on bottled water due to the nitrate contamination of their shallow aquifer drinking water wells, while not providing monetary compensation for those land owners who installed a deep aquifer well (because of prior knowledge of the shallow aquifer nitrate contamination) or who have delayed installing either a shallow or deep aquifer well. Some of the comments requested that EPA do something about this matter.

The purpose of replacement well installation is to protect the health of people who otherwise would have the potential for unsafe exposure to nitrate-contaminated shallow aquifer groundwater. Those who have drilled their own deep aquifer wells, fortunately, have eliminated their own risk of exposure. EPA generally does not have the authority to intercede in private party disputes regarding alleged property damage or losses.

A few comments stated that, because of additional water demands on the deep aquifer, certain wells that previously had been artesian would require the installation of pumps, resulting in increased costs. EPA is aware that the installation of new deep wells may impact the availability of water for other nearby wells. EPA also recognizes that some landowners have incurred or may incur expenses due to the lowering of deep aquifer water levels (whether the lowering of deep aquifer levels was due to new deep well installation or other possible causes). Because the ANP site is not located in an area designated by the Arizona Department of Water Resources as an Active Management Area (AMA), there are no legal restrictions that would prohibit parties from drilling wells on their property to withdraw water from either the shallow or deep aquifer. EPA believes requiring cleanup of the shallow aquifer and ensuring safe water for those who have relied on the shallow aquifer for domestic use are appropriate measures to protect human health and the environment, and EPA will seek to avoid possible inadvertent negative impacts of the selected remedy.

Other comments recommended that the St. David water supply system be extended to accommodate new residents in areas of nitrate-contaminated groundwater that otherwise will be forced to drill deep aquifer wells. EPA also recognizes that future population growth, including the need to supply potable water, will continue to be a concern in the Benson/St. David area. To resolve these issues, discussions should be held among landowners, ANP, and local representatives, including the St. David water supply system officials. EPA will, to the extent practicable, facilitate such discussions and will perform other actions as necessary to protect public health.

4.6 Effectiveness of Remedy

Four of the five selected remedial actions in the ROD received general concurrence by the community, with the exception that ANP did not concur with EPA's recommendations for additional soil sampling. For details, see section 5.4 for EPA's responses to ANP's comments.

However, the selection of constructed wetlands to treat the nitrate-contaminated shallow aquifer received numerous comments, as discussed above. EPA believes many of these concerns will be resolved during the first phase of the remedial design at the conclusion of the various studies previously discussed. EPA agrees that the shallow aquifer extraction system, including the siting of the extraction wells and the recharge locations, including pumping rates, needs to be carefully reviewed and considered once additional, updated data are gathered. Additionally, if new information becomes available supporting the inclusion of an agricultural irrigation component, EPA could modify the remedy, if appropriate. However, until these additional analyses are completed during remedial design, any specific changes to the selected use of constructed wetlands for treatment of the shallow aquifer would be premature.

5.0 Detailed Response to Comments

This portion of the Responsiveness Summary responds to more specific or technical comments made or submitted during the public comment period. These include the comments by the state agencies, ANP and certain community members. This section also includes responses to specific questions raised during the public meeting that were not answered at the public meeting or in the previous section.

<u>5.1 Comments from Arizona Department of Environmental Quality (ADEQ) -Letters of July 25, 1994 and August 11, 1994</u>

1. General Comment: "The Arizona Department of Environmental Quality (ADEQ) concurs with EPA's proposed groundwater and soil cleanup alternatives at the Apache Powder Superfund Site, as generally outlined in the above referenced Proposed Plan".

Response: Thank you for the comment.

2. Capping of the Inactive Ponds: Regarding the proposed alternative for the inactive ponds at the site (capping), ADEQ wishes to emphasize the importance of the development of a plan to monitor the integrity of the caps and to verify that the ponds do not act as a continuing source of groundwater contamination. Monitoring methods may include collection of physical data associated with the ponds, such as unsaturated zone monitoring, in addition to visual inspections of the capped ponds.

Response: EPA will take these recommendations into account during the design of the remedy and the development of monitoring plans to ensure that the ponds do not act as a continuing source of groundwater contamination. ADEQ will have the opportunity to review and submit comments on the monitoring plans before EPA approves them.

3. Future Use of Inactive Ponds: ADEQ recommends that continued consideration be given to the development of a mechanism(s) restricting future use of the capped, inactive ponds. These mechanisms may include deed restrictions, notice to the deed and/or fencing.

Response: EPA shares these concerns and has included institutional controls in the ROD. Any future site use must be consistent with the remedy and not compromise the integrity of the caps on the inactive ponds.

4. Post-Closure Monitoring for Inactive Ponds: In the event additional sampling during the RD phase at the site indicates that inactive pond sediments can be classified as a Resource Conservation and Recovery Act (RCRA) Hazardous Waste, then post-closure monitoring and notice to the deed may be required.

Response: EPA agrees that if any inactive pond sediments are determined to be a RCRA hazardous waste, the ROD may need to be revised to proved post-closure monitoring and/or other requirements.

5. Reconsideration of Agriculture Use Alternative for Shallow Aquifer: The determination of the preferred remedial alternative for the contaminated shallow aquifer should include a reconsideration of the agricultural use alternative. This alternative, or a combination of wetlands and agricultural use, may offer an effective method of treatment.

Response: Based on current information and the nine criteria analysis, EPA believes that the use of constructed wetlands is the best alternative for treating the shallow aquifer. The effectiveness of agricultural irrigation as a method of treatment depends on many variables, such as the concentrations of nitrate in the influent to be treated. Agricultural irrigation, as an alternative for secondary treatment or end use, will be further evaluated during the initial stages of RD. Until additional analyses are completed during RD on the concentrations of nitrate in various portions of the plume and on the potential land acreage and crops available for irrigation, any specific changes to the selected use of constructed wetlands would be premature.

6. Crop Irrigation as Secondary Treatment of Water: ADEQ believes that the irrigation proposal warrants consideration by the EPA as secondary treatment of the (shallow aquifer ground) water. Such treatment may or may not replace a secondary wetlands treatment system, depending on the amount of water which can feasibly be distributed to the farmers.

Response: As stated in EPA's response to ADEQ's comment #5 above (p.3-9), EPA intends to have additional analyses completed during RD to explore the potential use of crop irrigation as secondary treatment or end use.

7. Factors to be Considered to Ensure Nitrate Contamination is Not Spread to Previously Uncontaminated Soils and Groundwater: Given the extremely high nitrate content of the shallow aquifer groundwater (approximately 300 parts-per-million, or 810 lbs of nitrogen per acre foot of water, in some locations), ADEQ is concerned that applying the groundwater to various parcels in the St. David area may create a high potential for spreading contamination to previously non-contaminated soils and groundwater. Thus, various factors should be considered for each farm, including soil type and properties, method and procedures of irrigation, pumping rates, concentration of nitrates in the groundwater at the time of the application, and nitrogen consumptive use of the crops. These factors and conditions may vary farm to farm.

ADEQ feels that a high degree of assurance that contaminants will not be spread to other areas is needed, prior to approval of the irrigation proposal.

Thus, it would be appropriate to reduce nitrate concentrations through a primary treatment system initially, prior to applying the groundwater on the fields. In addition, groundwater monitoring should be conducted in association with each farm to ensure that impacts to the underlying groundwater are not significant.

Response: EPA concurs with ADEQ's comments and recommendations. As stated in EPA's responses to ADEQ's comments #5 (p.3-9) and #6 (p.3-9) above, EPA will take measures to ensure that the necessary data is gathered and analyzed regarding the agricultural irrigation option during the first phase of RD to fully evaluate the technical feasibility of this proposal.

8. Avert Impact on the Base Flow of the San Pedro River: One of ADEQ's primary concerns with a shallow aquifer remedy at the site involves the hydraulic connection between the shallow aquifer and the San Pedro River (SPR). The selected remedy should be designed to avert an

impact to the base flow of the SPR. Additional information on the effects of the remedy on the SPR will be obtained early in the remedial design phase. Such data may suggest that a substantial amount of treated water should be returned to the SPR, either directly or indirectly, to sustain current base flows. Depending on factors such as irrigation methods used on the various farms and the location of the farms relative to the SPR, the irrigation proposal may not support recharge to the SPR.

Response: EPA concurs that additional studies will need to be done during the first phase of the remedial design on the hydraulic connection between the shallow aquifer and the SPR to ensure that pumping and extracting of shallow aquifer groundwater does not adversely impact the base flow of the SPR.

9. Arizona Water Quality Standards: Treated water to be returned to the aquifer and/or the SPR must meet Arizona Water Quality Standards. This should be specified in the final ROD as an applicable or relevant and appropriate requirement.

Response: EPA concurs with this comment. Please see page 2-30 of the ROD.

10. Details of an Agricultural Irrigation Alternative: ADEQ has raised several issues regarding an irrigation alternative, including long-term commitments from farmers using water, restrictions on the farm size, compliance with State regulations when applying water, and siting of the farms near the San Pedro River and the primary treatment stage of the constructed wetlands.

Response: EPA believes that these are important issues which require further consideration during RD, when a more complete evaluation of the irrigation alternative will be conducted.

5.2 Comments from Arizona Department of Water Resources (ADWR)

1. General Comment: "The Department concurs with the Proposed Plan with he understanding that downstream water rights holders are not affected, that base flows in the San Pedro River are mainlained to appropriate levels and that any water withdrawn be put to reasonable and beneficial use."

Response: Thank you for the comment. See EPA's response to ADWR's comment #2 (p.3-11) below.

2. Groundwater Withdrawals Performed Pursuant to Remedial Actions at the Apache Powder Company (APC) Superfund Site May Result in Negative Impacts to Downstream Users: Any groundwater withdrawals performed pursuant to remedial actions at APC that affect base flows in the San Pedro River (SPR) may be considered surface waters and may result in negative impacts to downstream surface water right holders. If downstream rights holders were affected, those rights holders would have the option to take legal section in state court.

Response: EPA acknowledges the potential impact that pumping and extraction could have on the base flows in the SPR and downstream surface water right holders. As stated In the response to ADEQ's comment #8 (p.3-10), EPA will require additional studies during the RD to ensure that pumping and extracting of shallow aquifer groundwater does not adversely impact the base flow of the SPR.

3. Withdrawn Water Must be Put to Reasonable and Beneficial Use: In order to be consistent with applicable laws, water withdrawn pursuant to remedial actions must be put to reasonable and beneficial use.

Response: EPA concurs with this comment.

5.3 Comments from the State of Arizona Office of Attorney General on EPA's Feasibility Study

1. Request for Corrections to Citations in the Appicable or Relevant and Appropriate Requirement (ARARs) Tables in the Feasibility Study (FS): The Arizona AG's Office has requested corrections to the following tables: Table 3-2 (Potential Chemical Specific ARARs for Groundwater, TabIe 3-5 (Chemical Specific ARARS for Soil, Wash 3 Area (Excluding the Ash and Burn Area, and Table 3-6 (Potential Action-Specific ARARs for the Apache Nitrogen Products, Inc. Site) in EPA's Feasibility Stludy (FS).

Response: EPA has made 1he requested changes. See Table 11 (p.2-30) and Table 12 (p.2-31) and Appendix A (p.2-39) of the ROD for corrected versions of Tables 3-2, 3-5, and 3-6.

5.4 Comments from Kimball & Curry on behalf of Apache Nitrogen Products, Inc., (ANP)

1. Inclusion of Previous Comments on RI/FS in the Administrative Record: Numerous documents containing comments by and on behalf of ANP previously have been submitted to EPA regarding various aspects of the RI/FS and relating to the proposed remedy. At the time that these comments were submitted, ANP requested that they be included in the administrative record of this matter. ANP repeats that request by this reference, and requests that EPA respond to ANP's previous comments as provided in 40 C.F.R. Section 300.815.

Response: Given the general reference to previous submissions, EPA cannot identify with specificity the documents and comments to which ANP is referring. EPA has attempted to include all correspondence by and on behalf of ANP regarding the RI/FS and relating to the proposed remedy in the administrative record. EPA has considered the documents and comments contained in the administrative record. EPA is responding to ANP's comments submitted during the comment period, and believes that these responses, plus the responses to other comments, adequately address issues raised by ANP in documents contained in the Administrative Record.

2. Inclusion of ANP's Document. "Risk Assessment. Apache Nitrogen Products" in the Administrative Record: There is one document, "Risk Assessment, Apache Nitrogen Products" (Woodward-Clyde Consultants, July 13, 1992), which contained comments previously submitted by or on behalf of ANP relating to selection of the proposed remedy and which is not referenced in the Proposed Plan or the final RI or FS reports. In case this document has not already been included in the administrative record, a copy is enclosed for inclusion in the administrative record and response by EPA.

Response: EPA will include ANP's document, "Risk Assessment, Apache Nitrogen Products" in the administrative record. EPA relied on the Baseline Public Health Evaluation/Ecological Assessment (PBHE/EA) prepared by ICF Technology Incorporated for EPA in September 1992. EPA has reviewed ANP's risk assessment in conjunction with completing the Record of Decision and has concluded that there are no major disparities between EPA's selected remedy and ANP's findings in the risk assessment.

3. Validity of ANP's June 25, 1993 Proposal for Remedial Action: By letter dated June 25, 1993, ANP submitted a proposal for remedial action, based upon the RI/FS prepared by Hargis + Associates. ANP continues to believe that the proposal made last year is a valid approach to remediation. EPA's proposed plan is similar to ANP's plan with respect to most of the areas at the site, with the exception of the remediation of the shallow aquifer. ANP's proposal provided for a more selective approach to pumping from the shallow aquifer for treatment. ANP believes that public comments made at the July 6, 1994 public meeting regarding water conservation and concerns regarding the impacts of pumping on the flow of the San Pedro River stated in EPA's FS support ANP's more selective approach to pumping, which would reduce the pumping rate. ANP believes that this approach would be fully protective of human health and the environment. At worst, ANP's plan might take a few years longer to achieve cleanup goals in the shallow aquifer. However, a reduced pumping rate would reduce the risk of adverse impact to the flow of the San Pedro River and alleviate the other concerns regarding water conservation.

Response: EPA concurs with ANP's assertion that the June 25, 1993 proposal for remedial action has merit, and EPA has considered this proposal in selecting its remedy. However, for purposes of preparing EPA's FS Report, EPA did not alter the assumptions made by Hargis + Associates regarding the quantities of soil and volume of groundwater requiring remediation. Rather than spend additional dollars on a new theoretical model, EPA continued to use Hargis + Associates existing data and assumptions for the purposes of preparing EPA's revised FS report. However, EPA believes additional data gathering and analyses (groundwater modeling, aquifer tests, etc.) need to be performed during the first phase of remedial design to determine if modifications or adjustments can be made to the cleanup remedy. EPA agrees that more refinement of the assumptions on pumping rates and the location of extraction wells should be developed during remedial design to account for seasonal weather conditions, the specific subsurface geology of the recharge location, and to minimize the impact on the flow of the San Pedro River or on the water rights of downstream users. See EPA's responses to ADEQ's comment #8 (p.3-10) and ADWR's comment #2 (p.3-11).

4. Use of Constructed Wetlands is Preferred by ANP for the Shallow Aquifer: With respect to the proposed method of treatment, the use of constructed wetlands is preferred by ANP over the other treatment methods for the shallow aquifer discussed in the FS. However, ANP requests that EPA give serious consideration to comments made by local landowners regarding the use of water pumped from the shallow aquifer for irrigation use. As long as irrigation use would not increase the costs of the project and as long as water rights issues can be resolved, ANP would support this alternative approach.

Response: EPA concurs with ANP that potential irrigation use as a component of the treatment remedy for the shallow aquifer should be considered in more detail. EPA believes this option for agricultural use as secondary treatment or as end use should be analyzed in greater detail during the first phase of remedial design. See EPA's responses to ADEQ's comments #5 (p.3-9), #6 (p.3-9), #7 (p.3-9), and #10 (p.3-10).

5. EPA's Assessment That Use of the Shallow Aquifer for Drinking Water Presents the Only Risk to Public Health or the Environment: ANP wishes to highlight that EPA's own assessment indicates that use of the shallow aquifer for drinking water presents the only risk to public health or the environment. Notably, the only designated use for which a state numerical aquifer water quality standard exists is for drinking water. As EPA is aware, ANP is currently installing deep aquifer drinking water wells for those residences where shallow aquifer drinking water wells have been shown to have nitrate concentrations above the maximum contamination levels ("MCLs"). This project will be completed within a few weeks, and will result in the replacement of all residential wells where there has been a verified exceedence of the MCL.

Response: EPA has highlighted the risk posed to infants if nitrate-contaminated groundwater is ingested. However, as stated in EPA's risk assessment, RI report, and FS report, health risks also are posed by the perched groundwater which continues to contaminate the shallow aquifer and by the soils contamination on the site.

6. Cut-Off of Nitrate Flows to the Shallow Aquifer Will Strongly Attenuate the Nitrate Concentrations in the Shallow Aquifer: Once pumping of the perched aquifer begins, the cut-off of flows to the shallow aquifer will strongly attenuate the nitrate concentrations in the shallow aquifer as fresh upstream water flows mix with the remaining waters in the shallow aquifer. As the FS admits, even if no action is taken, "dispersion and dilution of the COC's to concentrations that would not exceed MCL would occur over a period of several years. " Although ANP does not suggest that the no-action alternative be adopted, it does believe that EPA should more seriously consider a modified alternative GS-1B that includes institutional controls and discrete groundwater pumping. Again, EPA states on page 5-6 that this alternative would "reduce the potential for exposure to surface water and groundwater containing concentrations in excess of the MCLs on a short term basis," and "on a long-term basis, natural dilution from recharging and dispersion caused by surface water flows and groundwater movements and natural biological degradation would reduce concentrations of the COC's to concentrations less than the MCLs and allow removal of the restrictions on use of the groundwater."

Response: EPA is aware that some dispersion and dilution would occur in the shallow aquifer. However, the timeframe required is not short-term. Hargis + Associates concluded in ANP's FS report that the time-frame is up to 90 years for attenuation to reach MCLs if no action is taken on the shallow aquifer, assuming the perched groundwater is pumped and treated. ANP's FS further states that even if the shallow aquifer is pumped and treated at a rate of 500 gpm, the treatment period is still 35 years to reach 10 parts per million (ppm), according its calculations. EPA agrees that discrete pumping may be an appropriate approach to ensure there are not adverse impacts on the base flow of the San Pedro River. However, until additional hydrogeological studies are conducted during RD, the optimum pumping rates, (including consideration of discrete pumping) cannot be selected.

7. ANP Believes That ADWR's Authority Could Restrict the Drilling or Use of Wells in the Shallow Aquifer. Thereby Making the No Action Alternative an Implementable Option: EPA did not evaluate the no action alternative for the shallow aquifer because it believed that there were no state or federal laws or regulations "that could restrict the drilling and the use of wells in the shallow aquifer." Of course, given that ANP currently is providing drinking water wells to affected residences, the only potential exposure which could cause a risk is nitrate contaminated groundwater from new drinking water wells, and EPA's statement that state regulations could not restrict the drilling and use of new wells in the shallow aquifer is not

wholly accurate. First, all of the residences which have or will receive new, deep aquifer drinking water wells have agreed to not use the shallow aquifer for drinking water purposes. In addition, Arizona laws and regulation allow the Department of Water Resources ("DWR") to limit the installation and construction of new wells. All wells must be registered with the State, and construction of new wells must be approved before installation. At that time, DWR has the opportunity to review well siting and could prohibit the approval of a drinking water well in an area of poor water quality. Given that authority, ANP believes that the GS-1B alternative is implementable, would be protective of the health and the environment, and should be considered more fully prior to issuance of the ROD.

Response: EPA does not concur with ANP's position on the extent of ADWR's authority regarding "the restriction of drilling and the use of wells in the shallow aquifer". At the public meeting, a question was asked whether there was a potential for deed restrictions to be placed on private property adjacent to the site. The question was answered by a representative of ADWR, who stated that ADWR does not have the authority to deny the drilling of wells or the proper drilling of wells or extraction of groundwater in this area, since it is a non-active management area. Because the site is not located in an active management area in which ADWR regulates water rights and water use, EPA did not consider the no action alternative a protective or an implementable alternative. Even if the State had the authority to restrict well drilling, EPA does not consider such institutional controls to be an adequately implementable or protective alternative.

8. ANP Believes a Sufficient Remedy is to Cut-Off of the Perched Zone, and Install Deep Aquifer Drinking Replacement Wells. Combined with Discrete Shallow Aquifer Groundwater Pumping and Treatment in Specific Areas of Low Flow Where Nitrate Concentrations Appear to Accumulate: With the cut-off of the perched zone, and the installation of drinking water replacement wells, ANP believes that this will be a sufficient remedy to address the requirements of CERCLA. Moreover, ANP could combine this with discrete pumping and treatment in specific areas of low flow where nitrate concentrations appear to accumulate.

Response: EPA agrees that cut-off of the perched zone will reduce nitrate flow to the shallow aquifer and that installation of deep aquifer replacement wells will reduce the potential risk of exposure to nitrate in the shallow aquifer. But these reductions alone would not be an adequate remedy. (See EPA's responses to ANP's comments #6 (p.3-14) and #7 (p.3-15).) The presumption of nitrate accumulating in certain areas of the shallow aquifer is questionable. The appearance of nitrate accumulation in specific areas may be due to the locations and construction details of existing wells. Based on existing data, the effectiveness of discrete pumping in terms of meeting remedial action objectives cannot be estimated. Additional hydrogeological studies must be completed to determine the exact number and location of extraction wells necessary to hydraulically control and remediate the nitrate-contaminated shallow aquifer groundwater. See EPA's responses to ADEQ's comment #8 (p.3-10), ADWR's comment #2 (p.3-11), and ANP's comments #3 (P.3 12) and #6 (p.3-14).

9. ANP and the Local Community Believe That Heavy Pumping of the Shallow Aquifer is the Wrong Solution and That The Benefits Should be investigated of Pumping Water From the Shallow Aquifer For Use Directly to Irrigate Agricultural Crops or to Support the Riparian Area: Public comment at the recent public hearing indicated that the local community also believes that heavy pumping of the shallow aquifer is the wrong solution. Although ANP has not had the opportunity to fully investigate whether water pumped from the shallow aquifer could be used directly for irrigated agriculture or to support the riparian area, these alternatives also should be evaluated prior to issuance of the ROD. The benefits that this water could provide would justify abandonment of the wetlands alternative.

Response: EPA concurs that either an end use or a secondary treatment option of agricultural irrigation or riparian enhancement should be evaluated during the first phase of RD for shallow aquifer groundwater. At this time, however, EPA does not concur with ANP's statement that these potential uses of the shallow aquifer groundwater will be of sufficient benefit to not require primary and/or secondary treatment by constructed wetlands. Unless additional analyses (to be conducted during the first phase of RD) indicate that the concentrations of nitrate in the shallow aquifer are much lower than previous sampling has indicated, initial primary treatment of the groundwater by constructed wetlands will be necessary. Blending of the contaminated groundwater within the plume may be feasible for reducing the concentration of influent. Blending may be possible by inserting mixing devices into the piping system for the extraction wells; but, most likely a constructed wetlands "holding" pond would be needed, both as a large mixing vessel for completing the blending, and as a storage vessel during rainy or freezing conditions, when the water could be mismanaged if suddenly released or allowed to flood.

10. ANP Believes EPA's Selection of the Capping Alternative for the Inactive Ponds Offers a Protective Yet Cost-Effective Remedial Solution. But Does Not Believe That Additional Characterization of These Ponds is Required: ANP also believes the EPA selection of the capping alternative for the inactive ponds offers a protective yet cost-effective remedial solution, because this alternative will prohibit the further mobilization of any pollutants or contaminants in these ponds. However, ANP does not agree that extensive additional characterization of the ponds is required during the remedial design phase.

Response: EPA concurs that the capping of the inactive ponds is a protective and cost-effective solution. However, EPA does not concur that no additional soil characterization in the inactive ponds is necessary. EPA will require that at least a minimal level of baseline data, to be determined during RD, be collected from each of the inactive ponds prior to final capping and closure. The number of samples required during RD will vary with each pond, depending on the number of samples collected during prior investigations. The rationale for this requirement is that the investigative studies conducted during the PI and the RI focused on establishing the presence of contamination, not the extent of contamination. The sediments and surrounding soils of many of the inactive ponds were never sampled during these prior investigations. In order to determine the lateral extent of capping required at the edges of the inactive ponds as well as to document the characteristics of the soils being capped, EPA will require additional characterization as part of the final remedial design and remedial action for these inactive ponds.

11. ANP Believes that the Management (Either Through On-Site Storage or Off-Site Disposal or Treatment) of the Contaminated Soils in the White Waste Materials and Drum Storage Area (Vanadium Pentoxide) Are Required Under the State's Consent Decree (CD). Since No Specific Exemption for the Characterization and Management of These Materials Was Included Under the CD: EPA's preferred remedial alternative for the white waste materials and the vanadium pentoxide is off-site disposal. At this time, ANP is required under the Consent Decree it recently entered into with the State of Arizona and the ADEQ to characterize all waste materials on the site and properly manage those materials, either through on-site storage or off-site disposal or treatment. The CD does not include an exemption for the white waste or vanadium pentoxide. Because there is no specific exemption for these materials, ANP believes that these materials can be managed under the CD and in a manner that actually will expedite the removal of the materials from the Apache site. ANP believes that the handling of these materials should be deleted from the ROD, and EPA should allow prompt management of the materials under the CD.

Response: EPA does not concur with ANP's position that the contaminated soils in the White Waste Materials and Drum Storage Area, including the vanadium pentoxide, should be managed under the State's CD rather than under the EPA ROD. EPA has contacted the State of Arizona regarding ANP's interpretation of the lead responsibility for these areas, and the State concurs with EPA that the White Waste Materials and Drum Storage Area contamination should be addressed under the CERCLA ROD. EPA and the State of Arizona previously agreed that EPA's ROD will cover specific areas of historical contamination, including the White Waste Materials and Drum Storage Area, while the State's CD will cover areas of active hazardous waste management.

12. ANP Believes that the Excavated Soil from Wash 3 Currently Stored On-Site Also Should be Managed Under the State's Consent Decree (CD): ANP believes that the excavated soil from Wash 3 that currently is stored on-site also should be managed under the CD. As it is, the drums of soil are being stored on-site awaiting the issuance of the ROD and the final excavation of Wash 3. The management of these soils under the CD would expedite their removal from the Apache site.

Response: EPA does not concur with ANP that the cleanup of the Wash 3 contaminated soils should be managed under the State's CD. EPA has contacted the State of Arizona regarding ANP's interpretation of the lead responsibility for this area, and the State concurs with EPA that the Wash 3 Area contamination should be addressed under the CERCLA ROD. The Wash 3 Area also was included in EPA's ROD, based on prior agreements between EPA and the State of Arizona, as discussed above under EPA's response to ANP's comment #11 (p.3-17).

13. ANP Agrees That the Excavation and Off-Site Disposal of the Contaminated Soils Is The Most

Practicable Remedial Action for the Wash 3 Area. However, ANP Does Not Agree That Additional Soils Characterization is Necessary: Although ANP agrees that the excavation and off-site disposal of the Wash 3 soils is the most practicable remedial action to address Wash 3, ANP does not agree with the EPA's determination that additional characterization of the Wash 3 Area is necessary.

Response: EPA does not concur with ANP that additional characterization of the Wash 3 Area is not necessary prior to final removal of contaminated soils. EPA is aware that characterization sampling was conducted by ANP during the course of conducting Phases I-IV of the Wash 3 investigation, and the initial removal of drums and contaminated soils to an on-site central accumulation area. ANP's sampling and removal of dinitrotoluene (DNT)-contaminated soils was based on an assumption that 200 mg/kg (ppm) DNT would be sufficient as a cleanup standard (based on Hargis + Associates' risk calculation of 104). However, because EPA has selected the State's soil cleanup standard for DNT of 140 mg/kg, additional surface soil sampling will be required to ensure that ANP has cleaned up the Wash 3 area to this standard. In addition, because of the potential for lead to migrate from the Ash and Burn Area to other surrounding areas within the Wash 3 Area, additional surface soil sampling will be required for lead.

14. ANP Disagrees With EPA's Statement in the EPA RI and FS Reports That ANP's RI 2nd FS Reports Were "Incomplete" Because of "...Unresolved Technical Differences, Missing Data and New information" and ANP Counter Argues That ANP Excluded Certain Disputed PI Data From ANP's RI and FS Reports Because of Poor Quality Control, inappropriate Sampling Methodology, and Erroneous Interpretation of the Data: In both the RI and FS produced by EPA/Bechtel, it is alleged that ANP's RI and FS report were "incomplete" because of"...unresolved technical differences, missing data and new information..." However, the Technical differences are not outlined nor are the differences discussed in terms of how these differences are handled in the reviewed documents. Review of the document indicate that the interpretation of the data and resulting conceptual model of groundwater flow and fate and transport of compounds of concern did not change. The only change apparent from the original ANP RI and FS is the inclusion of the EPA Preliminary Investigation (PI) data and interpretations from the PI. The ANP documents use these data selectively because of poor quality control, inappropriate sampling methodology and erroneous interpretation of the data....Due to these problems with the PI data, ANP did not include these data in the RI. However, the fact that these data were no used did not impact the conclusions or interpretations in the ANP RI or FS. In fact, the EPA proposed remedy for soils and groundwater do not differ from the remedial actions proposed by ANP with exception of the shallow aquifer treatment technology.

Response: ANP has selected on of the three reasons offered by EPA, "missing data", as the primary basis for EPA's determination that ANP's RI and FS reports were determined to be inadequate by EPA and, therefore, revised. While the missing PI data, as discussed by ANP, was one reason EPA revised ANP's RI and FS reports, the other two reasons were of equal if not more important weight.

During the period of 1989 through 1993, continual "unresolve technical differences", with the State of Arizona and EPA disagreeing with ANP, existed regarding the extent and levels of nitrate contamination in the shallow aquifer. ANP's unwillingness to revise or correct hydrogeological evaluations and conclusions in both ANP's RI and FS, after repeated requests by EPA, was one of the primary reasons EPA determined that ANP's RI and FS reports were inadequate and required revisions by EPA.

The second major reason for the revisions was "new information", regarding treatment technologies for treating the perched and shallow aquifer groundwater. In early 1994, EPA became aware that ANP had proceeded to design a brine concentrator to treat its process wastewaters and potentially the contaminated perched groundwater. However, this treatment technology (forced evaporation) was not selected for detailed analysis as a treatment alternative for the perched groundwater in ANP's FS report.

Additionally, only a limited number of biological treatment technologies were mentioned for treatment of the shallow aquifer groundwater. Of these, only anaerobic denitrification in reactor tanks was retained for detailed analysis in ANP's FS report. There are several treatment technologies involving anaerobic denitrification, including constructed wetlands, which are viable methods for denitrifying nitrate and which appear more cost-effective than the physical treatment technologies (e.g., reverse osmosis, electrodialysis reversal) evaluated in the ANP FS report. Because of the volume of water requiring treatment, the estimated cost for treatment of the contaminated shallow aquifer comprises an estimated 75% or more of the total projected costs for the site cleanup required under CERCLA. According to the literature, significant cost savings can be realized by the use of constructed wetlands. EPA believes that ANP and the public have benefited from EPA's further consideration and selection of this option.

15. ANP Takes Exception with EPA's Unwillingness to Acknowledge the Validity of ANP's Risk Assessment Prepared by Woodward-Clyde Consultants, Especially Given the Inadequacies of EPA's Draft Baseline Public Health Assessment (BPHE) Report: All references to the Risk Assessment (RA) document prepared for ANP by Woodward-Clyde Consultants were deleted from the EPA final documents, and large sections of the RI and FS have been changed to include risk evaluations that were not available to ANP during the preparation of the ANP RI and FS. While the EPA took exception to the independent RA conducted by ANP, the work is valid and was necessary due to inadequacies of the draft Baseline Public Health Assessment (BPHE) report prepared by EPA. ANP's review of the BPHE found significant problems with the approach in the BPHE, and provided comments to EPA. At the time, EPA indicated that no additional work was planned to correct the inadequacies in the BPHE report. However, it is apparent that the BPHE was revised and the results of the revisions were included in the EPA's final RI and FS. In the final analysis, these changes do not result in significant differences in ANP's proposed remedial actions and the EPA proposed remedy, although they could make a difference in setting cleanup levels. Again, the major difference being the recommended treatment technology to be used to remediate the shallow aquifer groundwater.

Response: EPA did not acknowledge the validity of ANP's risk assessment primarily because it did not include the data from the PI in its calculations. EPA did not revise the 1992 EPA BPHE document. The changes or additions noted in EPA's RI and FS reports in the presentation of the risk assessment data were a result of a reevaluation of the BPHE data by EPA's contractors (Bechtel Environmental, Inc.) during the process of preparing the revised RI and FS reports. In addition to reformatting the data already included in the 1992 BPHE into a more readable format, one additional set of calculations was completed to establish a site-specific risk level based on the data in both the PI and the RI. These new, additional calculations were added as an additional column to several tables in EPA's Rl and FS reports for analytical purposes to provide a full range of possible cleanup standards for consideration and final selection in the ROD.

16. ANP Agrees That Some Refinement of the Data Are Needed and Some Specific Design-Related Data Are Yet to be Gathered. But ANP Believes That EPA's Recommendations For Further Soils and Groundwater Investigation and Characterization During RD Constitutes a Large Site Assessment Effort and That It is Premature to Identify These Data Needs: Recommendations for further investigations required for developing a remedial design of the selected remedies are presented. However, details regarding these "required" investigation is limited. These investigations are significant efforts that, as outlined, imply major expenditures. Although ANP agrees that some refinement of the data are needed and some specific design-related data are yet to be gathered, it appears that the recommendations in these documents constitute a large site assessment effort. H + A believes that some of the required data will be collected as part of source control work conducted by agreement with the Arizona Department of Environmental Quality (ADEQ). Examples of these data include the additional work in the perched groundwater area planned as part of the Aquifer Protection Permit (APP) studies that will define the extent of the perched groundwater system, and soils sampling that is proposed for RCRA closure and non-RCRA closure of some of the facilities on the plant site.

The work to be conducted for ADEQ as part of the recently-signed Consent Decree and investigations for the Aquifer Protection Program (APP) application will supply additional data regarding soils and pond sediments for some of the active pond areas. Additional sampling at some of the inactive ponds can be included in that sampling to evaluate the potential size of the areas around the ANP ponds that needed to be remediated or capped. The waste and drum storage area will also supply additional soils data. Therefore, H + A believes that the need for additional characterization work should be determined at the time the RD/RA plans are developed.

Some of the soil sampling described in the EPA document also may not be necessary. Previous sampling in the inactive pond areas indicate that the areas impacted by ANP wastes are not extensive. It is possible that investigation of selected inactive ponds can guide the remediation efforts without extensive and expensive sampling at all locations.

Response: If missing data will be gathered as part of other investigative or source control efforts (for example, characterization of the perched groundwater) conducted by ANP in response to the State's CD, EPA agrees that additional data gathering may be unnecessary. Assuming that any data collected by ANP would be provided to EPA readily upon request, EPA concurs that it may be possible to keep additional sampling requirements to a minimum. However, EPA does not concur with ANP's assessment that sufficient soils and groundwater characterization data have been collected to date, with the exception of some specific design-related data. EPA believes additional soil sampling is required in the area of the Inactive Ponds (see EPA's response to ANP's comment #10 (p.3-17)) and in the Wash 3 Area (see EPA's response to ANP's comment #13 (p.3-18)). Additionally, EPA believes additional characterization is required to define the vertical and lateral extent of the nitrate-contamination in the shallow aquifer in the areas north and north-west of the site study area (see EPA's response to ANP's comment #17 (p.3-22)).

The full extent of this additional characterization work may not be easy to define at one time during the RD/RA planning stage. EPA believes this sampling work will likely be completed in multiple phases, commencing with some sampling in the pre-design phase, followed by some sampling during the development of the RD plans and drawings, some sampling during the actual removal of the contaminated soils or extraction of the contaminated groundwater, and some sampling after completion of the RA to ensure compliance with the ROD cleanup standards and to monitor the success of the remediation.

At a minimum, a certain level of base-line water and soils data will need to be collected in the near future, since over two years have elapsed since any on-site data has been collected. The only data collected during the last two years in areas of the site covered by EPA's ROD have been a limited amount of water quality data from shallow aquifer private wells identified for replacement in the Alternative Domestic Water Supply Plan (ADWSP). All other data collected in the last two years have been data collected to support the State's CD for aquifer protection or for hazardous waste management, in areas of the site study area not covered by EPA's ROD.

17. ANP Agrees That Some Additional Data Will Be Needed for Final Design of the Groundwater Extraction and Treatment System, But ANP Believes That it is Premature to Identify Data Collection Needs Since Other Sampling Activities Required For Either the Installation of the Deep Aquifer Replacement Wells or For ADEQ as Part of State's CD Will Supply Additional Data: Some of the additional data needs alluded to in the EPA Rl and FS documents will be necessary for final design of the groundwater extraction system and treatment system, but H + A feels that it is premature to identify data collection needs at this point. Sampling to be conducted for the well replacement work under the alternative drinking water supply activities will provide additional current and future data on the extent of the shallow aquifer contamination and the effects that source control will have on the groundwater system.

Response: EPA does not concur with ANP's conclusion that it is premature to identify specific data collection needs until other site cleanup activities have been completed, as detailed above in EPA's response to ANP's comment #16 (p.3-21). In particular, EPA strongly believes that the full lateral extent of the nitrate-contaminated shallow aquifer plume should be defined. Sufficient, accurate data must be available to landowners planning to install wells north and north-west of the ANP property. The current lack of data on the location of the leading edge of the contaminated plume is unacceptable, if the public is to be duly and properly informed about potential risks. Additionally, monitor wells should be installed to monitor the performance and effectiveness of the constructed wetlands treatment system. If the extraction and treatment process is working, eventually there should be nitrate reductions at the north end of the plume.

18. ANP Believes That Drilling of Additional Monitor Wells to the North and Northwest of the Site Study Area May Not Be Necessary to Characterize the Extent of the Nitrate Concentrations in the Shallow Aquifer Groundwater Requiring Remediation: H + A also believes that some of the work recommended by EPA may not be necessary. For example, EPA recommends drilling monitor wells to the north and northwest of the site study area. In addition to sampling conducted as part of the Alternative Drinking Water Supply Plan (ADWSP), there may be private shallow aquifer wells in these area that can be sampled initially to determine if any or all of the wells proposed by EPA are necessary to determine if groundwater in this area contains nitrate-N concentrations that require remediation.

Response: EPA does not concur with ANP's statement that drilling of additional monitor wells to the north and northwest of the site study area may not be necessary. Monitor wells of a known design (e.g., where the screened interval is known) are needed to collect accurate water quality and water level data, to determine more accurately the extent of contamination and the direction in which the plume is moving. Even if a sufficient number of production wells exist in appropriate locations, the water levels reflect local conditions due to pumping and the part of the aquifer from which water for the sample is being with withdrawn. In many instances, the screened interval on existing production wells is unknown or inappropriate. The data collected for the ADWSP does not address these data needs. (Also, see EPA's response to ANP's comment #17 (p.3-22)).

19. ANP Believes the Costs For Performing Further Investigation for Developing a Remedial Design Could Add Substantial Costs to the Remedial Alternatives. Particularly Because the Scope of These RD Investigations Were Not Defined: The FS did not incorporate costs for performing the RD investigations. These costs could add substantially to the estimated costs of the alternatives, particularly because the scope of the RD investigations is not defined. For example, additional work is proposed for Wash 3. A year ago H + A provided EPA with a Phase IV report that described the clean-up status of Wash 3. All 2,6- and 2,4-dinitrotoluene (DNT) drums and known contaminated materials were removed and contained. Post-removal sampling was performed and results reported to EPA. This document was referenced in the FS, yet EPA states on p. 1-32 that "The characterization...of DNT in...Wash 3...is not complete."

Response: EPA does not concur with ANP's comments that further sampling and investigative work will add substantial costs to the RD/RA cost estimates. Five areas have been identified in the ROD for design and remediation, including three areas with soil contamination. As discussed above under EPA's responses to ANP's comments #10 (p.3-17) and #13 (p.3-18), additional soil samples may need to be collected and analyzed. Even if it were determined that 100 additional samples (at an estimated cost of $1,000 per sample, including sample collection, analysis, and management oversight) were required, the total cost for additional soils characterization would be only another $100,000, on top of the $2.57 currently estimated for the soils cleanup portion of the ROD.

Regarding a requirement to characterize the perched groundwater contamination, ANP expressed in comment #16 (p.3-21) that ANP will be completing this work as part of its separate requirements under the State's CD. The shallow aquifer groundwater contamination is the remaining area requiring additional characterization. The nitrate plume in the shallow aquifer already has been characterized reasonably well on the south and eastern edges as it migrates in a north-easterly direction from the site along the San Pedro River. A good data base has been developed for the area of the plume just north of the ANP site, as a result of the recent sampling conducted in conjunction with the installation of deep aquifer replacement wells for residences with contaminated shallow aquifer wells. The data gaps for characterization of the shallow aquifer have been described in detail under the response to ANP's comment #17 (p.3-22) above. At a minimum, additional monitoring wells will need to be installed to identify the leading edge of the plume. If it were determined that twelve wells would be required to define the "nose" of the plume (at a cost of $20,000 per well, including drilling, analysis, and management oversight), the total costs would be approximately $240,000.

An estimated additional $340,000 ($100,000 for soils and $240,000 for groundwater) of site characterization costs is not a significant sum when contrasted with the overall remedial cost estimate of $21.1 million, and when one considers that the site study area encompasses over 1,000 acres.

20. EPA's Clean-Up Goals Were Not Clearly Stated. Which Could Have a Significant Bearing on the Costs of the RD/RA: The clean-up goals are not clearly stated. This, of course, has a significant bearing on both the costs of the remedial action and the RD investigation.

Response: EPA did not include EPA's cleanup standards in the Proposed Plan because the selection of final cleanup standards is a component of EPA's final decision-making documented in the ROD. However, EPA's FS Report included several tables in sections 2.0 and 3.0 summarizing State of Arizona and federal soil and groundwater Preliminary Remediation Goals (PRGs), background levels, Health Based Guidance Levels (HBGLs), Site-Derived, Risk-Based Levels, Maximum Contaminant Levels (MCLs), and Health Advisories. While cleanup standards affect costs, in the case of the ANP site, EPA believes that the costs should not vary significantly from the estimated costs in EPA's FS report. The reason is that groundwater cleanup is the most costly component of the ROD ($18.5 million). The cleanup standard for nitrate, the primary contaminant of concern, is the federal and state MCL of 10 ppm. This standard was the same basis for cost estimates prepared for EPA's FS report (and summarized in EPA's Proposed Plan) and used by ANP's contractor for ANP's FS report.

In the case of soil costs, because most of the contaminated soils covered by this ROD are already drummed (vanadium pentoxide), accumulated in a central storage area (dinitrotoluene), or will be contained in place (metals and nitrate in the inactive ponds), there probably are not extensive areas for which additional excavation will be required. Even though some cleanup levels may vary from those used for purposes of the cost estimates in the FS Report, the costs for cleanup of the soils areas should not vary significantly.

21. ANP Believes That EPA's FS Did Not Consider Any Options Short of Full-Scale Clean-up of the Shallow Aquifer (For Example a Combination of Pumping in "Hot Spots" and Allowing the Remaining, Lower Concentration, Portions of the Aquifer to Self-Cleanse), With the Exception of the No Action Alternative: With the exception of the no action alternative, the FS did not consider any options short of full-scale clean-up of the shallow aquifer. The ANP FS, for example, considered a combination of pumping in "hot spots" and allowing the remaining, lower concentration, portions of the aquifer to self-cleanse. Additionally, EPA made several assumptions regarding the selected remedial action that need to be refined and may affect the estimated total cost of the shallow aquifer remediation. As previously stated to EPA, ANP intends to begin source control as soon as the brine concentrator is completed and tested. This will probably happen prior to construction of the shallow aquifer extraction well system and the wetlands and will probably have an impact on nitrate-N concentrations in the shallow aquifer. This could affect the amount of water that needs to be pumped and treated and therefore the length of time for cleanup to occur, both of which impact cleanup cost estimates significantly.

Response: EPA did not develop multiple alternatives with various pumping rates for the FS report because, until additional groundwater modeling and aquifer tests are conducted, it is premature to assume the optimum pumping rate(s). See EPA's responses to ANP's comments #6 (p.3-14), #7 (p.3-15), and #8 (p.3-15). For purposes of comparing the various treatment technologies (physical, biological, and chemical), EPA used the assumptions of H + A's groundwater model that a pumping rate of 720 gpm would be needed to clean up the aquifer in the shortest time frame (12 years).

Rather than expand EPA's FS report to include numerous options that may not be applicable to the particular situation at the site, EPA assumed that additional analyses would be completed during the initial stages of remedial design after new, updated data are gathered. Various factors (season of the year, the subsurface geophysical conditions, the precise location of "hot spots") need to be evaluated to determine optimum pumping rates for containing or controlling the migration of the plume and optimum recharge rates for returning the treated groundwater back to the shallow aquifer.

22. ANP Believes There May Be an Impact on the Amount of Water That Needs to be Pumped and Treated From the Shallow Aquifer and the Corresponding Costs. Once the Brine Concentrator is Completed and Tested and Source Control Measures Begin:

Response: EPA agrees that there may be an impact on the amount of water that needs to be pumped and treated from the shallow aquifer and the corresponding costs, but EPA does not believe the impact will be so great that there will not be a need to remediate the shallow aquifer. RD will include monitoring this expected impact, as soon as the brine concentrator goes on line in April 1995. An initial focus should be placed on monitoring the impact of ceasing the discharge of ANP's process wastewaters to the active, unlined evaporation ponds, combined with extracting the perched groundwater from the underlying contaminated zone.

23. ANP Believes There Will Likely Be A Lengthening in the Projected Cleanup Time Beyond 12 Years (Since the Estimated 12 Year Cleanup Time Was Based on the Theory That the Flushing Effects of the Injection Wells Would Increase the Gradients Around the Extraction Wells and Speed Up the Remediation Process). If the Proposed Wetlands Replace the Injection Wells For Recharge: Another factor not considered in EPA's FS is the fact that the proposed wetlands will replace the injection wells used in the numerical modeling conducted for the FS. The injection wells were simulated in the modeling effort to shorten cleanup time. This is based on the theory that flushing effected of the treated water and the increase in gradients around the extraction wells in high concentration areas of the aquifer would speed up the remediation

process. The impact of using the wetlands recharge option instead of injection wells is not known at this time: However, it is likely the impact will be that the cleanup time using the wetlands recharge method will lengthen the cleanup time beyond the 12 years estimated using injection wells and potentially increase the cost of the remedy. In any case, there may be opportunity to refine the design and decrease or avoid increasing costs by evaluating a "hot spot" cleanup scenario, customizing the extraction well system design based on conditions after source control is implemented, or reevaluating the location and design of the wetlands treatment system.

Response: EPA's aware that alterations in the basic conceptual design, including the use of recharge wetlands versus the use of reinjection wells, may alter cleanup times and long-term projections. As stated earlier in response to ADEQ's comments on impacts of pumping on the San Pedro River base flow, EPA concurs with the need to complete a revised groundwater model for the site.

24. Certain Directions and Comments Provided to ANP During the Preparation of ANP's FS Drafts Precluded Options Involving Wetlands and Agricultural Treatments and the Blending of Perched Groundwater in the Brine Concentrator to be Used for Source Control, While EPA's Contractor (Bechtel Environmental) was Not Limited by These Constraints:

Response: EPA reconsidered various treatment technologies when EPA revised ANP's FS report. EPA reevaluated the use of the brine concentrator for treatment of the perched groundwater and the use of biological treatment technologies (including constructed wetlands) for treatment of the shallow aquifer groundwater. EPA believes that ANP and the public have benefitted from EPA's further consideration of these options.

25. EPA's RI Report States That ANP is the Only Source of Nitrate Within the Study Area, While the EPA FS Resort States That the Pomerene Canal and Local Septic Systems May Be Sources of Nitrate:

Response: Based on the available data, EPA believes that ANP, as a result of the company's manufacturing of nitric acid, is the primary source of nitrate within the study area, and, in particular, is the primary or only source nitrate contamination on the west side of the San Pedro River. However, some low levels of nitrate contamination in the range of 2-5 ppm can be detected in shallow aquifer wells on the east side of the San Pedro River, in the vicinity of St. David. These levels are consistent with the expected "background" levels of groundwater nitrate contamination detected in any agricultural or rural area where there are irrigation ditches, a large number of farms applying fertilizers to crops, and local septic systems. None of the nitrate levels detected on the east side of the river in the vicinity of the ANP site study area exceed the federal maximum contaminant level (MCL) of 10 ppm, with the exception of one private well adjacent to the Pomerene Canal. In general, these "background" nitrate levels range from 20 to 100 times lower than the levels detected in wells completed in the nitrate-contaminated shallow aquifer plume on the west side of the San Pedro River

<u>5.5 Comments from Border Ecology Project dated July 5, 1994.</u>

1. Development of a Wetlands Holds Promise as a Remediation Strategy as Long as Fauna, Flora (or Humans) Are Not Exposed to a Contaminated Area: The development of a wetlands as a major component of an Apache Powder remediation strategy appears to hold promise, assuming that the wetlands does not, itself, become a collector of contamination nor a magnet that attracts fauna, flora (or humans) to a contaminated area.

Response: The use of constructed wetlands to treat the nitrate contamination in the shallow aquifer most likely will attract fauna and flora tend perhaps humans). However, the luring of any of these species to the wetlands is not considered to be placing any of these species at risk, with the exception of infants if they should ingest the nitrate-contaminated water. Nitrate is the only contaminant of concern in the shallow aquifer groundwater. There are no metals or other organic compounds of concern that have been detected above background in the shallow aquifer. The only other water quality characteristic of the shallow aquifer is a high concentration of total dissolved solids (TDS), primarily sulfate. The constructed wetlands should be successful at both denitrifying and removing the nitrate, but also filtering and reducing the TDS levels.

Nitrate, which acts as a nutrient, should enhance the growth of the flora, which in turn should provide more habitat for the fauna. According to the U.S. Fish and Wildlife Service, certain amphibians could be at risk from the nitrate. Fortunately, none of these species are known to inhabit this particular vicinity of the San Pedro River. If humans are attracted to the constructed wetlands, the appropriate signs and/or fencing will be needed to ensure that no one drinks water from the constructed wetlands area.

2. The Role of Apache Nitrogen Products as a Major Single Source Air Polluter Was Not Addressed by EPA's Proposed Plan: During the June 7 presentation by EPA and consultants at the Water Resource Center, I was aware that the role of Apache Nitrogen Products as a major single source air polluter was not addressed. I have not researched emissions data for these brief comments. Suffice it to say that the visible plume at Apache -– measured by opacity -- has increased markedly, if irregularly, over the past year or two; concurrent with an expansion in production at the plant. Arizona Dept. of Environmental Quality (ADEQ) has issued a revised air pollution permit that allows this increased production. Part of the data gathering process to develop groundwater remediation should include:

A. Distribution of concise forms to area residents living within 5 miles of the plant to determine whether they feel excessive air pollution is a problem. Anonymity should be guaranteed.

B. Examination of current continuous emissions monitoring (as well as any ambient monitoring data) for criteria and NESHAP (National Emission Standards for Hazardous Air Pollutants) pollutants under the 1990 Clean Air Act and Arizona law to determine the potential hazards to health and the environment.

C. Creation of a multi-topographical air quality model to ensure that an enforceable continuous emissions limit is established that could not impact sensitive individuals with respiratory problems nor any flora and fauna that grow currently or could grown in the region should a wetlands be established.

D. I have frequently seen a plume of smoke miles in length extending from the plant, that is clearly not an acceptable emission. Apache, as part of a long term remediation of groundwater strategy, should not be permitted to aerially pollute the ecology that it is going to create while cleaning up its past.

Response: EPA is aware of the history of air pollution issues at the site. Because the ADEQ is the lead agency for air emissions compliance, EPA forwarded these recommendations to ADEQ. ADEQ has asked EPA to include the following responses to these recommendations. For additional comments or questions regarding air emissions compliance, please contact ADEQ at (602) 628-6738 or (602) 628-6717.

A. Individuals are encouraged to telephone ADEQ at 628-6738 with complaints in regard to air pollution at the ANP facility. The ADEQ Southern Regional Office (628-6738) logs all complaints. Anonymity is permissible; however, individuals are encouraged to be prepared to give specific descriptions, times and dates of events. Citizens may call and register as many complaints about a source (of air pollution) as they feel necessary. All complaints are documented and filed at ADEQ. The complainant receives a copy of the complaint along with the source (ANP). Response actions to the complaints are handled by the ADEQ inspector responsible for the facility. The follow up inspection is done in accordance with EPA's Clean Air Act enforcement inspection levels (levels 0-4).

Also, in 1995 as part of the Title V permit process, ANP will be undergoing review for a Title V permit. Citizens can comment at public hearings and meetings held in conjunction with the new permit process, on whether they feel that source air pollution is effecting them or whether increased pollution control is required.

The above described complaint response protocol and inspection methodology are standard for every major source currently permitted by ADEQ's Air Quality Division. At this time, ADEQ does not believe that a deviation from department policy is warranted for this specific source (ANP). However, if new or increased air pollution should occur, ADEQ believes that adequate citizen input will be available through the forthcoming public hearing process mandated in the Title V air quality permitting process.

B. Current continuous emissions monitoring (CEM) is done and annually audited on the state level. Quarterly reports are submitted for review and periodic inspections determine source compliance with the criteria pollutant standards. The regulated pollutant is nitrogen oxide (NOx) and is measured at the stacks of nitric acid plants #3 and #4.

C. The current permit specifically limits emissions into the atmosphere of the contaminants nitric acid, ammonium nitrate particulate and ammonia. In addition the sources are subject to Arizona Air Pollution rules and the Code of Federal Regulations (CRF 40, part 60). Conservative dispersion modeling calculations of the maximum-ground-level pollutant concentrations, due to plant emissions, show that no ambient air quality standards (based on health effects) should be violated.

D. Sighting of smoke plumes: ADEQ research shows that under normal conditions, emissions from the plant should fall within health standards. During the oxidation process, water sometimes reacts with nitric acid to generate a puff of what appears to be white smoke. Chemicals are present only in trace amounts that pose virtually no health risk. Puffs of brown smoke containing nitrous oxide sometimes are generated during the nitric acid manufacturing process. The NOx is present only in trace amounts and poses virtually no risk. Plant upset conditions are to be reported to ADEQ within 24 hours; causes are investigated and trends documented.

3. U.S. Taxpayer Should Not Pay for the Apache Cleanup Costs: The Arizona or U.S. taxpayer should not be required to pay for any of the cost of Apache's cleanup -- from monitoring to control.

Response: Consistent with EPA's approach at Superfund sites nationwide, EPA intends to seek cost recovery from ANP for all costs incurred by EPA to oversee or conduct any response actions at the site. EPA also will negotiate with ANP or, if necessary, take enforcement actions to have ANP perform the work required by the ROD. A central feature of Superfund is that those who caused or contributed to the contamination are responsible for the costs of investigation and cleanup.

5.6. Comments from Julie Stromberg, Assistant Research Professor, Arizona State University, Center for Environmental Studies

1. Be Careful In Considering the Idea of Constructed Wetlands: First of all, I would be very careful in considering the idea of constructed wetlands, particularly if they are to accomplish the dual purposes of nitrate reduction and habitat creation. Dr. Joy Zedler of San Diego State, and others, have done much work assessing the functioning of constructed wetlands, and found that despite all good intentions they generally do not function near the level of their natural counterparts and do not have long-term sustainability. It is true that cienegas are a rare ecosystem type in the Southwest, but it also has not been demonstrated that we know how to recreate them, especially when we are trying to achieve water purification as a main goal.

Response: EPA appreciates your comments and realizes that combining the goals of treatment of nitrate-contaminated groundwater and habitat creation would require careful planning and execution. In regards to the success of constructed wetlands, a recent EPA study completed in August 1993, "Habitat Quality Assessment of Two Wetland Treatment Systems in the Arid West: A Pilot Study", was designed primarily to examine methods and the usefulness of various wetland indicators for assessing the habitat quality of six wetlands treatment systems (WTS), constructed for treating municipal wastewater in the United States. This report focused on two of these sites, located in Show Low, Arizona, and Carson Valley, Nevada. A comparison of various wetland indicator values (e.g., vegetation, invertebrates, site morphology, birds) concluded that most indicator values from these two WTS were within the range of non-WTS (natural systems), and that the density and richness of bird species were above the range of values for non-WTS. Preliminary results of the two WTS studied indicated that the habitat condition is comparable with that of non-WTS in this arid region. A copy of this report will be made available for public review at the information repository in the Benson Library.

However, to clarify EPA's proposal, the initial or primary treatment would occur in a series of lined, highly managed constructed wetlands ponds with a primary objective to denitrify by an estimated reduction of 70% the nitrate-contaminated influent. The establishment of habitat for species (under more cienega-like conditions) would be a component of the secondary stage "leaky" or recharge wetlands, where the previously treated influent nitrate levels should be much lower than at the primary stage. The creation of these "cienega-type" wetlands would be treated as a pilot and, depending on the final siting location for the secondary stage recharge wetlands, may or may not be feasible.

2. Wetland Construction Would Result in Loss of Water (That Currently Sustains Rinarian Vegetation) From the Floodplain Aquifer: Wetland construction would result in loss of water from the floodplain aquifer, water that currently sustains existing riparian vegetation. A careful water budget for all-proposed methods should be prepared so that potential loss of riparian vegetation can be determined: The benefits from the constructed wetland vegetation can then be weighted against the loss of riparian floodplain vegetation. This analysis might reveal the denitrification tanks (no Evaporation-Transpiration (ET)) to be a desirable option.

Response: EPA is aware of the water balance issue, especially in this particular area of the San Pedro River that is located in close proximity to the San Pedro River National Conservation Area established by Congress to protect riparian resources. Groundwater modeling is planned for the initial stages of remedial design to ascertain the impacts of various pumping options and extraction locations on the base flow in the San Pedro River. See EPA's response to ADEQ's comment #8 (p.3-10) and ADWR's comment #2 (p.3-11).

3. Recommend Waiting Before Commencing Any Treatment Since Natural Rates of Nitrate Reduction. In the Absence of New Discharge. May Be More Rapid Than Are Presently Predicted: Before making a decision regarding the water purification treatment, be it constructed wetlands or denitrification tanks, I would suggest waiting a couple of years after the time when discharge of nitrates to the shallow aquifer ceases. If my question was answered correctly, then the numbers were calculated based on the assumption that "natural" purification would occur solely by physical processes (i.e., dilution, etc.). Biological processes were ignored, and could be substantial. We have been conducting some studies on the effluent dominated Santa Cruz River, and these studies suggest that the cottonwood-dominated floodplain can help to remove the nitrates, through direct uptake and enhanced growth rates (also found by Dr. Karpiscak of the Office of Arid Lands Studies at the University of Arizona), as well as by providing an environment for bacterial activity. The point of this is that natural rate of reduction, in the absence of new discharge, may be more rapid than are presently predicted; this in turn may mean that less water-intensive or less costly treatment are in order. I know that people want action now, but given that this problem has been around decades, another year or two of data collection should not be an unreasonable request.

Response: EPA recognizes that once ANP's process wastewater discharge is ceased and the extracted perched groundwater begins to be processed through the brine concentrator (estimated to be on-line by April 1995), there could be alteration to the current characteristics of the nitrate-contaminated shallow aquifer. Additionally, dilution plus the contribution of the biological processes already available in the existing San Pedro River Basin may contribute to reduced levels of nitrate in a more timely manner than currently predicted. In response to these possibilities, very focused monitoring of the shallow aquifer is planned as soon as the brine concentrator commences operation. See EPA's response to ANP's comment #22 (p.3-26) for a more detailed response.

<u>5.6. Comments/Questions from Private Citizens - Grouped by Category</u>

> NOTE: The written comment letters, received during the thirty-day public comment period of June 22 - July 25, 1994, are included in the administrative record. In addition, the oral questions and comments, received by EPA from private citizens at the July 6, 1994 public meeting, are included in the written transcript, which also is part of the administrative record located in the information repository in the Benson Library.

<u>ANP's History of Environmental Problems</u>

1. Apache Powder Has Willfully Created Many Serious Environmental Problems and Has Not Reduced the Harmful Effects, Resulting In the Residents Being the Victims of Apache's Misuse of the

Environment: Several community members expressed anger at ANP's actions to date, as summarized below:

A. It is our feeling that Apache Powder Company has made little effort to do the necessary clean up or pay for the extensive damage they have done in the St. David area. Contamination has continued during the whole Superfund study. This is clear evidence to us of a very calloused attitude. Talk and promises sound good, however the token fine assessed by the State of Arizona is hard evidence that they have little fear of being forced to deal fairly in resolving these problems, now or ever.

B. Apache Powder is the offender. They caused the problem. They should pay fully for the cleanup. They should be forced to place fail proof processes into operation. They should be monitored in every phase of their future manufacturing processes. Their previous performance clearly shows that nothing should be left to "good faith" performances on their part.

C. Apache Powder must be closely monitored. These people are not good neighbors and will circumvent requirements to save costs. How long have health officials known that nitrates are harmful? If Apache Powder is such a good community citizen, why didn't they act on their own to reduce known harmful effects on the public? As you may feel from my expressions, I'm very concerned and I'm very angry at Apache Powder. They have raped the environment and they continue to do so and will continue in the future if someone doesn't monitor them closely.

Response: EPA is aware of a high level of distrust among certain members of the community regarding ANP's past practices and commitment to clean up the site. As discussed in EPA's response to comment #3 (p.3-30) of the Border Ecology Project, EPA considers ANP to be the responsible party for the contamination and the cleanup. EPA expects ANP to fulfill its responsibilities to both reimburse EPA for costs already incurred and to perform remedial work, and will aggressively use its statutory powers if ANP does not comply voluntarily. These powers include ordering ANP to perform remedial work, with penalties for non-compliance. EPA is encouraged by ANP's recent commitment in a consent decree to undertake work for the State, and EPA has confidence that the State will strictly oversee that work.

<u>Expenses Incurred by Landowners to Drill Deep Wells</u>

2. Concerns Regarding Deep Aquifer Wells: Several community members expressed concerns about ANP's drilling of deep aquifer wells as replacements for shallow aquifer wells contaminated by ANP's operations. These concerns include the expenses incurred by landowners for drilling their own deep wells, the effects of the new wells on the level of the deep aquifer, and the option of city water rather than deep wells. These comments are summarized below:

A. What will EPA do to help an owner of a parcel just around the corner from Apache Powder, who has steadily improved the property and saved money to drill a shallow aquifer well and then discovers that he will have to drill a much deeper well because of the contaminated groundwater?

B. I was forced to drill a deep artesian well in order to assure myself of nitrate-free water. This was a great expense to me because of the high probability of contaminated groundwater. I would have preferred the cheaper cost of drilling for (shallow aquifer) ground water, but was unable to gamble on nitrate-free water in case the (shallow aquifer) ground water was contaminated.

C. Should Apache Powder continue the project of drilling deep wells for a select few property owners, they should also be required to pay for all additional operational costs this drilling causes to those with existing domestic deep wells.

D. We continue to express our disagreement on this item. There are two problems we see with this decision. First, it is discriminatory in that it does not treat all affected property owners equally. Other families have previously drilled wells to provide their families with usable domestic water. If there is to be a program of providing deep water wells for some families, there should be payment for all privately drilled domestic wells in the Superfund area.

Effects of New Wells on the Level of the Deep Aquifer

E. Stop Apache's discriminating drilling into the deep aquifer. It's lowering the deep aquifer now! My artesian well's static level drops each time another well is drilled. I'm being punished with reduced flow and increased pumping costs because Apache Powder polluted the ground water. I hold Apache Powder and those who forced this decision on them responsible. This was a very short-sighted solution for a few house holds. How does it help future landowners who may have valid claims against Apache Powder? How does it help me when I had to drill into the deep aquifer at my expense to get pollution-free water?

F. One possible solution to make up for the added (deep aquifer) wells they propose to drill would be a Record of Decision measure by EPA to require them to reuse their treated water in an amount equal to, or greater than, that which will be pumped from all drilled deep domestic wells. If the treated water is as pure as it has been reported to be, Apache Powder could greatly reduce the daily pumping from their deep wells by using treated water in their manufacturing processes. By so doing they would protect the current deep well water level.

G. Second, with the drilling of each well, the deep water table drops. The Carnes deep well for example, with the related pumping associated with purging that well, caused well owners to experience a lowering of the water level in their deep wells. Heretofore, each has had domestic water in a free-flowing form. With the drilling of several such wells, we will likely lose the free flow and be forced to make extra expenditures to purchase pumps for our wells. This will also require us to pay monthly utility charges to deliver our water to our homes.

Option of City Water Rather Than Deep Wells

H. There were and are now other solutions. The extension of the St. David water system, at the expense of Apache Powder, is the best solution. It would benefit those whose wells are now polluted, those in the future whose wells become polluted, and it would provide for growth. New customers should be charged in lieu of construction cost which could be rebated to Apache Powder. That way Apache Powder could recover some of their costs. How low much will they recover from continued deep well drilling costs now?

I. Our recommendation is to stop all this discriminatory drilling of the deep wells immediately. In exchange for wells, provide city water to each affected household in the Superfund area. This extension of the St. David water system should be paid for by Apache Powder. In addition, they should pay all monthly service fees for enough water to meet normal domestic needs. This charge should continue until such time as the surface water becomes clear of all the contaminants Apache Powder has deliberately injected into it over the years. While some argue that private drilling will eventually do the same damage to deep well owners as the current Apache Powder drilling, it should be pointed out that one is free enterprise and the other is an unjust imposition upon non-offending neighbors by a company which has been judged to be in violation of environmental law.

Response: Community members are understandably concerned about the many ramifications of new deep aquifer drilling. EPA has been attempting to work with the community and ANP to protect public health within EPA's regulatory authority. In 1989, EPA required ANP to supply bottled water to households that were using contaminated shallow wells for drinking water. In 1994, ANP began installing deep aquifer replacement wells for those households on bottled water. This plan was not discriminatory because EPA's mandate was to protect the health of those relying on contaminated water, which does not extend to households that already had potable water. In approving the Alternative Domestic Water Suppiy Plan (ADWSP), EPA considered the option of city water. EPA ultimately approved deep wells based on the preferences of the households on bottled water.

EPA recognizes that future population growth, including the need for potable water, will continue to be a concern. Resolution of these issues will require discussions among landowners, ANP, and local officials, including the St. David water system operators. EPA will, to the extent practicable, facilitate such discussions and will perform other actions as necessary to protect public health.

EPA further recognizes that some landowners have incurred or may in the future incur expenses in drilling their own wells, or expenses by virtue of the lowering of the deep aquifer. Generally, EPA does not have the authority to intercede in disputes between private parties regarding alleged damages to property. EPA's authority and its priorities, are to protect public health and the environment by cleaning up the shallow aquifer and ensuring safe water to those who have relied on the contaminated shallow aquifer.

Regarding ANP's use of deep wells for its operations, EPA expects this to reduce dramatically once the brine concentrator goes on-line in April 1995. ANP currently withdraws approximately 135 gallons per minute (gpm) from the deep aquifer. In the future, only "make-up" water is expected to be withdrawn, since all the treated wastewater will be recycled into ANP's plant operations.

<u>Impact of Pumping on Base Flow of the San Pedro River (Shallow Aquifer and Surface Water)</u>

3. Shallow Aquifer Pumping as a Cleanup Measure. Several comments expressed concern regarding the impact of pumping on the shallow aquifer and the surface water. These comments are summarized below:

A. We feel strongly that no decision by EPA should call for heavy pumping of surface water as part of the clean up process. Secretary of Interior Bruce Babbit recently commented on the dropping water table in the San Pedro Basin and expressed concern about how to resolve the matter. He felt that the problem was so severe that it merits extension of the CAP canal system to Sierra Vista. It is far better to stop all contamination of the ground water and then do follow up studies to determine what kind of surface water clean up will take place naturally.

B. The wetlands decision is a very costly solution with unknown consequences on the ground water level. There most likely will be a lowering of the water table causing users additional pumping costs. Many more people may be affected. The San Pedro River is a beautiful and precious resource and hasty decisions may adversely affect it. Who would want to be responsible for damaging it because of hasty decisions? Defer your decision for a period of five years. Continue to monitor pollutants in existing wells and test wells. Please don't be in a hurry to spend money and take unknown risks.

Response: EPA concurs that additional studies will need to be conducted to determine the impact of the remedy on the shallow aquifer and the base flow of the San Pedro River. Final decisions on the location of extraction wellsand pumping rates, including whether certain areas are "self-cleansing", will not be made until these studies are completed.

However, in regards to wetlands being a cause of groundwater loss, any treatment alternative (other than no action) will require extraction, treatment, and recharge or reinjection of the groundwater, and as a result, some water loss. With wetlands, one would have optimum flexibility to pump at various rates or not to pump at all and hold the water in the wetlands (if necessary due to storm conditions or other circumstances). Additionally, when compared to other nitrate treatment alternatives, constructed wetlands are a less expensive alternative both in terms of initial capital costs and long-term operations and maintenance costs than all other applicable treatment technologies.

See EPA's responses to ADEQ's comment #8 (p.3-10), ADWR's comment #2 (p.3-11), ANP's comments #6 (p.3-14), #21 (p.3-25), and #22 (p.3-26), and the Center for Environmental Studies, Arizona State University's comment #2 (p.3-31), for additional details.

<u>Use of Constructed Wetlands to Treat the Shallow Aquifer</u>

4. Wetlands Proposal for Shallow Aquifer Clean-up. We have two major problems with the wetlands concept. First is the increased well owner costs in pumping water from a lowered water table. This, in effect, transfers cleanup costs from Apache Powder to every well owner in this portion of the San Pedro Basin. Second, we are very concerned about federal funds paying for a

project on private land. Here we have the tax payers paying a major portion of the cleanup costs and Apache Powder continues to pollute at taxpayers' expense. The proposed wetlands would very likely be unavailable to the public for park purposes, as it would be on Apache Powder property.

Response: As stated in EPA's responses to the citizens' comments included under #2 (p.3-34) above, the lowering of the water table due to additional wells being installed into the deep aquifer and any consequent additional pumping costs to adjacent well owners is a private party issue that is generally outside the scope of EPA's authority.

Regarding federal funds being spent at the taxpayer's expense, EPA will seek cost recovery from ANP for all costs incurred by EPA to oversee or conduct any response actions at the site. EPA also will negotiate with ANP or, if necessary, take enforcement actions to have ANP perform the work required by the ROD.

In response to an interest in public access to the wetlands, during the remedial design phase the final siting location will be determined. Although the primary focus will be on selecting a location where treatment can occur safely and cost-effectively, consideration will be given to siting the secondary phase recharge wetlands in a location available to the public for viewing.

5.   Excellent Idea to Construct Wetlands: Excellent idea to construct artificial wetlands for the shallow aquifer remediation, as constructed wetlands are very effective in treatment of contaminated water.

Response: Thank you for the comment.

6.   Does This Process (Constructed Wetlands) Take Lots of Water?

Response: The use of constructed wetlands is a treatment technology (a biological treatment technology) similar to the use of reverse osmosis or electrodialysis reversal (physical treatment technologies), which can be used to treat wastewater. It takes no more or less water than any other treatment technology. The amount of water treated by the technology is dependent on the extraction rate. ANP's consultant (Hargis & Associates) estimated in 1992 that approximately 720 gpm should be extracted from the shallow aquifer to treat the nitrate-contamination by reverse osmosis. This calculation will need to be updated based on new aquifer tests and revised groundwater modeling.

EPA does anticipate some net loss of water through evaporation. Water loss in a wetlands can be due to two factors: infiltration through the bottom and evaporation-transpiration (ET) off the surface. Both of these factors are a function of the surface area given a constant flow rate. The primary wetlands will be lined with a liner to not allow any infiltration loss. The ET losses will vary with the growing season, the relative humidity, the temperature, and the wind speed. Generally, this is about equal to the open water evaporation loss in the region.

7. What is the Daily Water Requirement (for the Constructed Wetlands)?

Response: See EPA's response to citizen comment #6 above (p.3-38).

8.   Where Will Apache Get the Water (for the Constructed Wetlands)?

Response: The water to be treated in the constructed wetlands would be extracted from the area of the nitrate-contaminated plume in the shallow aquifer. See figure 2 on page 2 of EPA's Proposed Plan, dated June 22, 1994.

9.   Who Will Bear the Cost of This Experimentation (Constructed Wetlands)?

Response: ANP is responsible for the cleanup costs for treating the nitrate-contaminated shallow aquifer plume.

10. Where Does Apache Plan to Do This Experimentation (Constructed Wetlands)?

Response: The exact siting of the constructed wetlands will not be determined until the RD stage. However, at this point in time, EPA anticipates that the wetlands will be sited property owned and operated by ANP.

11. What Facts Provide Assurance That the Contaminants Will Not Be Transferred to Another Area and Consequently Nothing Gets Handled?

Response: Based on the literature and studies of currently operating wetlands, it is anticipated and constructed wetlands will be quite efficient at removing nitrate, the one contaminant of concern, from the shallow aquifer groundwater. The contaminated water will be pumped from the shallow aquifer and piped to the constructed wetlands with a well extraction system similar to the type of systems used for any other treatment technology. The primary treatment wetlands will be lined with a synthetic liner to prevent recharge of untreated water. See EPA's response to citizen comment #6 (p.3-38) above.

12. Provide a List of Operations and Their Duration in Other States That Have Done This Experimentation (Constructed Wetlands) With Organic Contaminants With No Complaints?

Response: An EPA paper published in September 1992, entitled "Constructed Wetland Design -- The First Generation", inventoried 150 constructed wetlands systems for the treatment of municipal and industrial wastewaters in the Unites States. The paper summarizes some of the results from the inventory, including: location, type, vegetation, design flow, loading rates, and costs for wetlands systems, where available. A copy of this paper will be made available for public review at the information repository in the Benson Library.

Some of the inventoried wetlands systems for municipal and industrial wastewaters described in this publication may be treating organic contaminants mixed in with domestic wastewater. However, fortunately in the case of the ANP site, there are no organic contaminants in the shallow aquifer groundwater. Because the contamination in singularly composed of nitrate, a wetlands systems for the Apache site would be designed for treating nitrate only.

Another EPA publication, "Report on the Use of Wetlands for Municipal Wastewater Treatment and Disposal," dated October 1987, also will be placed in the information repository. This report discusses the use of both natural and constructed wetlands for municipal wastewater treatment and disposal. A list of technical references also is included.

Use of Brine Concentrator to Treat the Perched Groundwater

13. Brine Concentrator is a Good Solution for the Perched Water. Several community members commented that the use of forced evaporation (a brine concentrator) for treating the perched groundwater was a good choice, as long as it was monitored for compliance. These comments are summarized below:

A. The brine concentrator is a good solution to clean up the perched water and to reduce deep water pumping by Apache Powder.

B. We fully support this recommendation. We cautiously point out, however, that it is just a turn of a valve to continue to dump contaminated water into unlined ponds instead of the flow of property treated environmentally safe water. We needed to hear that failure of the process would close down the plant. We also need to hear about the necessary enforcement to cause this to be practice, not just promise.

Response: As stated under EPA's response to the citizen comments included under #1 (p.3-31) above, EPA intends to monitor ANP's cleanup activities covered under the ROD.

Use of Agricultural Irrigation to Treat the Shallow Aquifer

14. Leaching Contaminants From the Surface Water by Pumping It Onto Private Land. This is a move in the wrong direction for many reasons. This option creates even more problems. There will be an even greater lowering of the water table, as very little of the irrigation water will return to the surface water reserves. The cost of pumping will increase for everyone. It might also provide a screen for Apache Powder to continue their polluting processes.

Response: Improper management of agricultural irrigation could result in the recycling of the contamination back into the shallow aquifer. See EPA's response to ADEQ's comment #7 (p.3-9).

EPA believes that additional studies need to be conducted during the first phase of remedial design to determine if agricultural irrigation is technically feasible and implementable as part of the remedy. See EPA's responses to ADEQ's comments #5 (p.3-9) and #6 (p.3-9).

15. Farmers Have Interest in Using Shallow Aquifer Groundwater With Nitrate Contamination on Their Growing Grasses and Use of Nitrate-Contaminated Water Could Offset Current Pumping. I have two good artesian wells on my property that are near Escalante Crossing which have flowed since we bought the property about 20 years ago, and have several 3 to 5 foot diameter cottonwood trees near them which make me think the old artesian wells have flowed for maybe 100 years. I am not sure of the exact date, but both of these wells quit flowing about 3 to 6 months ago.

Over the past years, I have read articles in the newspapers, and heard talks that the water table in the Sierra Vista - Fort Huachuca area is going down and there is a cone of depression in the water table in this area. This makes me think that water from this area that in past years flowed toward the St. David area, either underground, or in the "perennial" river may no long come.

In today's Tucson newspaper, the Arizona Daily Star, under precipitation it states: normal to date is 3.11 inches, actual to date is 3.01 inches, and normal annual rainfall is 12.0 inches. Tucson may not be St. David, but this whole part of the State is a desert and we should conserve what water we have.

Therefore, for the above reasons and other similar information, I think constructed wetlands will be too much of a water waste for here. I have talked to five of six farmers - ranchers in the area that either adjoin, or are close to Apache's property, and they all showed interest in using some of the shallow aquifer groundwater with nitrate contamination on their growing grasses and any water received from Apache would allow them to not pump an equal amount.

Response: EPA is aware of the interest in agricultural irrigation on the part of certain members of the community as an alternative to the use of constructed wetlands to treat the nitrate-contaminated shallow aquifer groundwater plume at the ANP site. As stated in EPA's responses to ADEQ's comment #5 (p.3-9) and ANP's comment #9 (p.3-16), agricultural irrigation will be evaluated during RD as a secondary treatment and/or end use option.

16. Agricultural Irrigation Proposal Submitted by Community Member. At the public meeting in St. David on July 6th about the Apache Powder Superfund site it was suggested by several officials that I write a letter explaining my suggestions further. I am no expert on this subject, but hope the names, addresses, acres, and costs are approximately correct.

For costs, I am using pages E-23 to E-27 in the Volume 4 Notebook (EPA's Feasibility Study) in the Benson Library... I would like to suggest that you go directly from several of these (extraction) wells to farmers' fields, and maybe make another extraction well as they are only $24,750 each, so you can cut your (piping) sizes to 4" or 6", and cut the total 33,000 feet (for the treatment system piping).

On page E-25 you itemize the costs to build two 9.0 acre ponds, which adds up to $2,226,000 and two 4.5 acre secondary ponds, which will cost $320,000. The total to build these ponds is $2,546,000, which you do not need to spend if you put the water on fields growing crops. (In this total you have 18 acres, plus 9 acres worth of plants at $8,000 per acre, which you will not have to spend because each farmer will have his fields planted.)...

My well pumps about 200 gpm and I irrigate about two acres at a time, using furrow irrigation, so I suppose that 720 gpm would irrigate about seven acres at a time using flood or furrow irrigation. But for people with sprinklers this could be different. But in any case, we would mostly be using the same amount of water in the same way as we do now, so there would be 27 acres that we would be saving the evaporation from...

I would suggest anytime there is rain that the wells be turned off. Because if a 1 inch rain were to occur while irrigating, there is a good chance that the nitrate water could go off of the property, it was intended to irrigate...

Dr. Gearheart, from Arcata, California, was one of the speakers at the July 6th meeting. After the meeting, he was kind enough to give me a paper on which he had figured the number of acres necessary to handle the nitrogen load at the 720 gpm and the 300 pounds of nitrogen per acre that I had mentioned during the meeting. At 300 ppm, the 720 gpm produces 2,600 pounds of nitrogen per day. This means one needs 8.6 acres per day, or a total of 3,000 acres.

Paul Brick, a San Pedro NRCD (Natural Resources Conservation District) member talked to Dave Matthews, who is the District Conservationist for the Soil Conservation Service. Dave felt that most crops in this area only need 200 pounds of nitrogen per acre, and he figured at 200 ppm, one would only require about 4 inches of water to get the 200 lb/acre. At 200 gpm, one needs 884 acres total.

Below are some names and addresses of some people that I know are near ANP and would like to cooperate to conserve water in this area.

Response: EPA will review the suggestions in your proposal in conjunction with evaluating agricultural irrigation as a treatment option either for secondary treatment or as an end use. See EPA's responses to ADEQ's comment #5 (p.3-9) and ANP's comment #9 (p.3-16) for further details.

Cleanup of Contaminated Soils

17. Cleanup of Buried Wastes. We are in complete agreement with the proposed soils removal in areas of dumping of solid wastes. We recommend extensive testing of their property with metal detectors as well as chemical detection equipment to make certain that every solid waste dump site has been discovered. Then EPA should enforce the cleanup of all buried materials located on their property. It is our impression, which has been reinforced by other local witnesses, that the company still operates on a basis "if it is not seen, it is not a serious environmental problem".

Response: EPA will be overseeing the cleanup of the contaminated soils during the remedial action. During the remedial design phase EPA will be incorporating the advice of technical experts on the appropriate level of sampling and monitoring required to ensure that the three areas of soils contamination are cleaned up as required in the ROD. EPA's efforts, combined with the soils characterization requirements in the State's Consent Decree, will greatly assist in the discovery and identification of any previously unknown areas of contamination.

Cost of Remedy

18. Cost of Remedy: The cost of the remedy seems very high. Can this cost be brought down?

Response: When the total cost is broken down into its five sub-component costs, an estimated $2.3 million is for cleanup of the perched groundwater, an estimated $2.6 million is for soils cleanup, and the remainder of $16.2 million is for constructed wetlands to clean up the shallow aquifer. The component with most potential for cost-savings is the constructed wetlands alternative for cleanup of the shallow aquifer. The costs for the shallow aquifer cleanup were based on the assumption that 720 gallons per minute (gpm) would be pumped from three extraction wells and would be piped over certain distances. During the initial stages of remedial design, EPA will require additional groundwater modeling and aquifer testing studies to refine this conceptual model to account for seasonal fluctuations in demand and the ability to maintain recharge at certain rates. In addition, the design will include evaluating the optimum siting location for the wetlands. Data gathered and analyzed during these studies may help reduce costs. EPA also will be overseeing the analysis of the potential use of agricultural irrigation to determine if additional cost savings can be attained by adding this component either as secondary treatment or as end use of the treated water.

Status of ANP's Current Operations and Cleanup Activities/Future Monitoring

19. Give a Current Update of ANP's Operation. Including: (a) Expansion of the Plant: (b) Names of Products Being Produced: (c) Condition of ANP's Equipment: (d) Ash Disposal and Burn Area: (e) Drum Storage: and (f) Status of Compliance with EPA's Remedial Projects.

Response: Because the Arizona Department of Environmental Quality (ADEQ) is the lead agency for overseeing ANP's active day-to-day operations, EPA forwarded your question to ADEQ. The following responses are based on the information provided by ADEQ. For additional information or questions regarding the status of ANP's active operations addressed in the responses to questions (a) through (d) below, please contact ADEQ at (602) 207-4191.

(a) ANP has been expanding its production of nitric acid and ammonium nitrate based products, and currently is closing down its manufacturing of commercial explosive products. ANP currently is recommissioning a second nitric acid plant, referred to as Ammonium Oxidation Plant #3 (AOP #3). AOP #3 is scheduled to be in full service in the fall of 1994.

(b) The products currently being produced by ANP are nitric acid, solid and liquid ammonium nitrate, blasting agents, and nitrogeneous fertilizer. ANP also distributes explosives materials to mining companies.

(c) ANP has been in operation since 1922. However, the equipment and structures currently in use date from the late 1970's. Older, historic areas of plant operations are closed or are in the process of being shut down. Some of the corresponding equipment is being dismantled and salvaged. Given the corrosive nature of the products manufactured at the plant, operating equipment requires continual maintenance.

(d) The Ash and Burn Area located in Wash 3 will be closed and remediated under the State's CD. ANP has had interim status under the Resource Conservation and Recovery Act (RCRA) for treatment of explosive wastes in this area. The Ash and Burn Area, also known as the Open Burn/Open Detonation (OB/OD) Area, currently is undergoing closure review by ADEQ under its RCRA program authority.

(e) The Drum Storage Area will be cleaned up in conjunction with the other areas of historical soils contamination identified in EPA's ROD. The area currently is used for the storage of drums containing vanadium pentoxide and storage of some nitrate-contaminated soils. During the remedial action under this ROD, these contaminated materials will be removed and treated off-site, prior to disposal. After removal of these materials, the Drum Storage Area will be resampled to ensure that the cleanup standards established in the ROD are met.

(f) ANP completed a remedial investigation (RI) report and a feasibility study (FS) report for the site. However, as stated in EPA's FS report, issued in June 1994, EPA determined ANP's RI and FS reports to be incomplete because of unresolved technical differences, missing data, and new information. See EPA's response to ANP's comment #14 (p.3-19).

20. What Are The Boundaries (North, South, East, and West) in St. David and Benson of the Contaminated Perched Groundwater and the Shallow Aquifer Groundwater Plume?

Response: The general boundaries of both the perched groundwater and the shallow aquifer plume are shown on Figure 2 on page 2 of EPA's Proposed Plan, dated June 1994. However, as stated at the public meeting held on July 6, 1994 in St. David, additional data will be gathered during the first phase of remedial design to further define these boundaries. See EPA's response to ANP's comments #16 (p.3-21), #17 (p.3-22), and #18 (p.3-23).

21. Which Ponds Are Unlined of the Following List: 1A. 1B. 2A. 2B. 6B, 7. Dynagel, and Sludge?

Response: All of these ponds are unlined. During ANP's cleanup activities under EPA's ROD and the State's CD, all of the active and inactive evaporation ponds will be closed and covered with a clay cap. The capped ponds will be monitored in the future to ensure the integrity of the caps.

22. What Action Will Apache Take to Clean Up Ponds 2A and 2B, Which Contain Most of the Metal Contaminants?

Response: Ponds 2A and 2B are addressed under the State's CD for final cleanup and closure. Based on discussions between EPA and the State, the capping of the active ponds, including Ponds 2A and 2B, will be completed in a manner similar to the capping of the historical inactive ponds covered under EPA's ROD. The caps will restrict direct contact and eliminate potential exposure to the contaminated soils left in place in the ponds.

23. Will a Different Type of Cleanup Procedure Be Required for Pond 7. Where a Lot of Nitrate-Nitrogen Was Found?

Response: No, all of the inactive ponds will be capped in a similar manner, with the contaminated soils and sediments left in place. The clay caps will be monitored as part of a long-term operations and maintenance plan to ensure that rainwater does not migrate through the cap and cause any further migration of contaminants.

Geology of the St. David Clay Formation

24. What Documented Data Backs Up That the St. David Clay is 400 Feet Thick and Impermeable?

Response: Data obtained from the drilling logs for local wells indicate that the St. David clay is hundreds of feet thick in the Middle San Pedro Basin, including the St. David area. Permeability tests conducted by Hargis and Associates indicate that the St. David clay has an extremely low vertical permeability (~ 10-8 cm/sec). For additional information on the stratigraphy of the area around the ANP site, please refer to ANP's RI and hydrogeological reports and EPA's RI report in the information repository in the Benson Library.

25. Are the Different Types of Soils and Stratums In and Around St. David Partof This 400 Foot (St. David Clay) Or Is This In Reference to the Land (Subsurface Geology) Around the Apache Plant?

Response: The St. David clay is a distinct geologic unit.

26. How Far Below The Surface Does the Impermeable Clay Begin?

Response: The subsurface geology of the area around the ANP site is comprised of alluvial deposits at or near the surface adjacent to the San Pedro River, with the St. David clay underlying these deposits at levels ranging from 10 to more than 300 feet (Gray, 1965).

27. Have Tests Been Done For Contaminants Below the Impermeable Clay? If So, Please Provide the Findings.

Response: Groundwater sampling from the deep aquifer, which is located beneath the St. David Formation at depths greater than 300 feet, has been conducted by both EPA as part of the Preliminary Investigation (PI) and by ANP as part of the RI. The sampling results detected elevated levels of naturally-occurring fluoride, strontium, and arsenic. None of the contaminants associated with ANP's explosives manufacturing processes have been detected in the deep aquifer.

28. What Type of Clay is Found in the St. David (Formation), Dry or Wet?

Response: The moisture content of the St. David clay is spatially variable. Details of the variability have not been characterized. Clays, by their nature, tend to retain relatively significant amounts of moisture relative to other lithologies, such as silts, sands, and gravels.

29. Do Frequent Earth Vibrations by the Use of Heavy Equipment Over a Period of Time Create Cracks or Fractures In Any Type of Clay?

Response: It is not known whether the use of heavy equipment over a period of time will create cracks or fractures in any type of clay, without specific studies being completed. It is very unlikely that heavy equipment would fracture the St. David clay, due to its plasticity and the lithostatic pressures it is subjected to at greater depths. Any cracking would only occur locally at the ground surface in areas where the clay may be dry.

30. Does Dry Clay Have Desiccated Cracks or Fractures?

Response: Dry clay may crack due to shrinkage associated with moisture loss.

31. What is the Composition or the Properties of the St. David Clay?

Response: The Upper St. David Formation consists primarily of lacustrine unconsolidated and consolidated red and brown clays and silts.

32. Constructed Wetlands for Treating Municipal Wastewater or Other Inorganic or Organic Compounds (Not Detected in the Shallow Groundwater at the ANP Site):

The following questions are asked in reference to the booklet, "A Natural, System for Wastewater Reclamation and Resource Enhancement, Arcata, California", which was distributed at a technical meeting held in Tucson, Arizona on June 7, 1994. (A copy of the booklet will be made available for public review at the information repository in the Benson Library.) The booklet describes the seven basic components of Arcata's present wastewater treatment plant. These components are the headworks, primary clarification, solids handling, oxidation pond, treatment marshes, enhancement marshes, and disinfection. Two of these components are constructed freshwater wetlands which receive partially treated wastewater for further treatment by marsh plants, soils and their associated microorganisms. The wetlands components are a cost-effective system that further treat the wastewaters, enhance the receiving water, and provide a wetland ecosystem and habitat for fish, shorebirds, waterfawl, raptors and migratory birds.

Please note that the Arcata wastewater treatment system is not a comparable system to the selected constructed wetlands treatment system for the ANP site. The ANP wetlands system will be designed to remove only nitrate, not the numerous compounds and constituents (sewage, gray water, storm water runoff, etc.) found in municipal wastewater. The Arcata wetlands system was used as an example in an EPA technical meeting held in June 1994 for the following purposes: (1) to illustrate what a constructed wetlands looks like, and (2) to demonstrate how nitrate (at domestic wastewater concentrations) is treated and removed in a constructed wetlands system.

A. It the Arcata wastewater treatment system) is "aimed at removing inorganic materials from the raw sewage". What about organic contaminants such as: benzene, carbon tetrachloride, 1,2 -dichlorethane, trichloroethylene, 1,1-dichloroethane, and vinyl chloride, which are known cancer causing chemicals?

Response: The phrase "aimed at removing inorganic materials from the raw sewage" is a phrase in the Arcata brochure describing the "headworks" component of Arcata's wastewater treatment plant. The headworks is the first phase in the treatment process where the influent of raw sewage and wastewater is received. The headworks consists of various technologies "aimed at removing inorganic materials". The reference to organic matter is human organic waste material, not chemical organic compounds (i.e., benzene, carbon tetrachloride, vinyl chloride, etc.). The headworks is not a component of the constructed wetlands project for the ANP site. None of the chemically manufactured organic compounds listed above were detected in the shallow aquifer. The only contaminant of concern in the shallow aquifer is nitrate, a by-product of ANP's nitric acid manufacturing processes.

B. What are the ingredients used in Arcata's two clarifiers?

Response: The "ingredients" processed by the two clarifiers in Arcata's wastewater treatment plant are wastewater containing raw sewage, and other possible waste products (for example, storm water runoff, pre-treated industrial wastewaters). The two clarifiers (which are one part of the seven part Arcata municipal treatment system) perform the primary clarification by settling out any remaining suspended material that passes through the headworks. See response to citizen question #32, A (p.3-48) above. This primary clarification component would not be part of the ANP constructed wetlands treatment process, since only nitrate (not raw sewage or other wastewaters) is being treated.

C. Arcata's treatment marshes "reduce the levels of suspended solids and BOD concentrations". What happens to the remaining waste that they do not handle?

Response: The purpose of Arcata's treatment marshes (constructed wetlands) is to reduce the levels of suspended solids and BOD (Biological Oxygen Demand) concentrations that remain in the oxidation pond effluent after secondary treatment. The treatment marshes are the fifth stage of the Arcata treatment system, following the headworks, primary clarification, sludge pumping, digestion, and methane recovery (cogeneration) components, and the oxidation ponds. At the point these pre-treated wastewaters enter Arcata's treatment marshes, the wastewater has received primary treatment and secondary treatment, and the "treatment marshes", planted with hardstem bulrush (Scirpus acutus), are performing further treatment. Any remaining waste materials after this phase of treatment are pumped to the "enhancement marshes" for a final stage of further treatment to ensure that the effluent meets federal and state water quality requirements.

D. "Chlorine gas is used" to disinfect Arcata's waste water. In the Arcata system, "double chlorination" occurs in two chlorine basins. Chlorine is a poisonous greenish-yellow diatomic gas that is very irritating to the nose, throat, and lungs, with suffocating odor. What is a safe distance so that the surrounding community will not smell or breathe the chlorine gas?

Response: Chlorine is required in the Arcata municipal wastewater treatment system to kill any pathogens or other organisms commonly found in wastewater composed of human waste materials to properly disinfect it prior to release to the environment. As stated above in EPA's responses to citizen questions #32, A and B (p.3-48) above, the shallow aquifer is contaminated with nitrate, not human waste materials. A chlorination disinfection stage would not be a component of the ANP constructed wetlands system.

E. What happens to chlorine gas when it accidentally combines with rare gases or nitrogen?

Response: As stated in EPA's response to citizen question #30, D (p.3-49) above, the use of chlorine gas is not a component of the constructed wetlands system selected for the ANP site.

F. In the Arcata system (any free chlorine remaining in the final effluent after the 60 minute contact time) "is removed with sulfur dioxide". Sulfur dioxide is a sharp, strong, suffocating odor. What is a safe distance so that the surrounding community will not smell or breath the sulfur dioxide?

Response: Because chlorine will not be needed or used in the constructed wetlands system for the ANP site, sulfur dioxide will not be used. See EPA's responses to citizen questions #32, D (p.3-49) and E (p.3-501 above. Concerns about exposure to either chlorine or sulfur dioxide (resulting from treatment of the nitrate-contaminated shallow aquifer by constructed wetlands at the ANP site) should be put aside, since these chemicals will not be used.

G. Does sulfur dioxide smell like rotten eggs?

Response: Sulfur dioxide does not smell like hydrogen sulfide (a rotten egg smell). However, as stated in EPA's response to citizen question #30, F (p.3-49) above, sulfur dioxide will not be used during the treatment of the nitrate-contaminated shallow aquifer groundwater in the constructed wetlands at the ANP site.

H. Does water enhance the smell of sulfur dioxide?

Response: As stated in EPA's responses to question #30, F and G (p.3-50) above, sulfur dioxide will not be used during the treatment of the nitrate in the shallow aquifer groundwater at the ANP site.